SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CRC 482	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Analysis of Unauthorized Absences and Desertions		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)* Philip M. Lurie		8. CONTRACT OR GRANT NUMBER*(s)* N00014-81-C-0841
9. PERFORMING ORGANIZATION NAME AND ADDRESS Center for Naval Analyses 2000 No. Beauregard Street Alexandria, Virginia 22311		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research Dept. of the Navy 800 N. Quincy St. Arlington, Va. 22217		12. REPORT DATE March 1983 13. NUMBER OF PAGES 68
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)* Scientific Officer Chief of Naval Operations Code Op-135 Washington, D.C. 20350		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT *(of this Report)*		
17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*		
18. SUPPLEMENTARY NOTES This Research Contribution does not necessarily represent the opinion of the Department of the Navy.		
19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)* Background, Desertion, Naval personnel, Regression analysis		
20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)* An analysis was performed on patterns of unauthorized absences and desertions in the Navy during the period FY 1979 - FY 1981. Separate analyses were done for absences in Class "A" school and during permanent duty. The effects of rating and apprenticeship group, as well as personnel and unit characteristics, on absence patterns over time were also examined.		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

CRC 482 / March 1983

ANALYSIS OF UNAUTHORIZED ABSENCES AND DESERTIONS

Philip M. Lurie

CENTER FOR NAVAL ANALYSES

EXECUTIVE SUMMARY

This report presents the results of an analysis of unauthorized absences (UAs) and desertions (DXs) for the period FY 1979 - FY 1981. It is divided into three parts--general information about UA/DX patterns, an analysis of UA patterns in Class "A" school, and an analysis of UA patterns and durations during permanent duty assignment. Below is a summary of our findings.

GENERAL INFORMATION

- Close scrutiny of UA/DX data provided to us reveals errors in the official monthly counts. In general, the CNA-derived monthly UA counts are lower than the official ones whereas our DX counts are higher.

- The CNA counts show a drop of over 16 percent in the UA rate from FY 1979 - FY 1981. The DX counts show a drop of almost 30 percent over the same period.

- Navy personnel with the highest UA/DX rates are Active Mariners and non-prior service (NPS) males. Other-service veterans also have high UA/DX rates but they are few in number.

- For the FY 1979 cohort, 3.6 percent of all UAs occur during boot camp, 21.4 percent occur during "A" school, and 75.0 percent occur during permanent duty assignment. The corresponding figures for DXs are 9.5 percent, 3.0 percent, and 87.5 percent.

CLASS "A" SCHOOL UA RESULTS

- Approximately 5 percent of all Class "A" school personnel have at least one UA incident.

- Given one UA incident in Class "A" school, the probability of another is 32.1 percent; given a second incident, this figure rises to 41.6 percent for a third.

- The best predictors of UA behavior are rating group and education. Personnel in the Hull group have a 7.9 percent UA rate compared to 1.4 percent in the Construction group. High school diploma graduates have a 3.4 percent UA rate, whereas non-high school graduates have a rate of 10.6 percent.

PERMANENT DUTY UA RESULTS

- Overall, non-designated personnel have much higher UA rates than designated strikers or rated individuals.

- Among designated or rated individuals, those in the Administrative, Hull, and Deck groups have by far the highest UA rates during permanent duty. Those in the Electronics and Cryptology groups have the lowest rates.

- Among non-designated personnel, those who have attended "A" school and failed have by far the highest UA rates.

- Aside from rating or apprenticeship group, the best predictor of UA behavior during permanent duty is a previous UA history, i.e., one or more UAs in boot camp or initial skill training. Other good predictors are education, age, and paygrade.

- Personnel with the highest propensity for multiple UA occurrences are Seamen, those with crime waivers, and those assigned to Carriers.

- The average length of a UA occurrence is 8.7 days for the first, 8.5 days for the second, and 8.2 days for the third.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

LIST OF TABLES (Cont'd)

INTRODUCTION

Since the advent of the All Volunteer Force in FY 1973, there has been a dramatic increase in the rate of unauthorized absences (UA) and desertions (DX) in the Navy. Although these rates leveled off in the early eighties and even show signs of declining slightly, they are still, in the view of the CNO, unacceptably high. Any attempt to control UA/DX rates, however, must be predicated on an understanding of the personnel and unit characteristics which predict them and on the environmental factors which cause them. Since the identification of environmental factors requires data which are currently unavailable to us, our research will concentrate instead on the relationships between personnel and unit characteristics and UA/DX behavior over time.

Much research has been done with regard to correlates of UA/DX behavior, primarily for the Army (see, for example, [1] through [5]). Surprisingly little, however, has been done for the Navy ([6] through [8]); further, there is little reason to believe that the Army results should apply to the Navy, since the Navy's mission requires extensive periods of time at sea. In addition, virtually all of the Army's studies have analytical flaws which render their results suspect. The most serious shortcoming is that length of service has generally been ignored. For example, it is a mistake to treat an individual with one UA in three years of service the same as someone with one UA in only three months of service. Merely counting the number of UAs without regard to the time frame in which they occur can be very misleading.

A partial solution to the problem of varying lengths of service is to consider a cohort of individuals having an active duty service date (ADSD) all in the same year. This way, personnel can potentially be observed for the same period of time. The only difficulty arises when there are early attritions, and this can be handled by statistical methods which take into account incomplete observations (see, for example, [9]).

Data on UA/DX behavior and some limited background information were extracted from Audit Trail Reports (ATRs), covering the period FY 1979 - FY 1981. The ATRs were first matched against the Enlisted Master Records (EMRs) for individuals with an active duty service data (ADSD) in FY 1979 to provide additional background information. Then individuals with an ADSD in FY 1979 but with no record of UA/DX behavior were added to the data base. Thus we can follow up to three years of UA/DX behavior (or lack thereof) for every individual in the FY 1979 cohort.

In the course of validating data for unauthorized absences and desertions, we found large discrepancies between the officially reported counts and those derived from the ATRs. It appears that errors in the official counts are the source of these discrepancies. This is because we found a large number of duplicate records (identical records for the

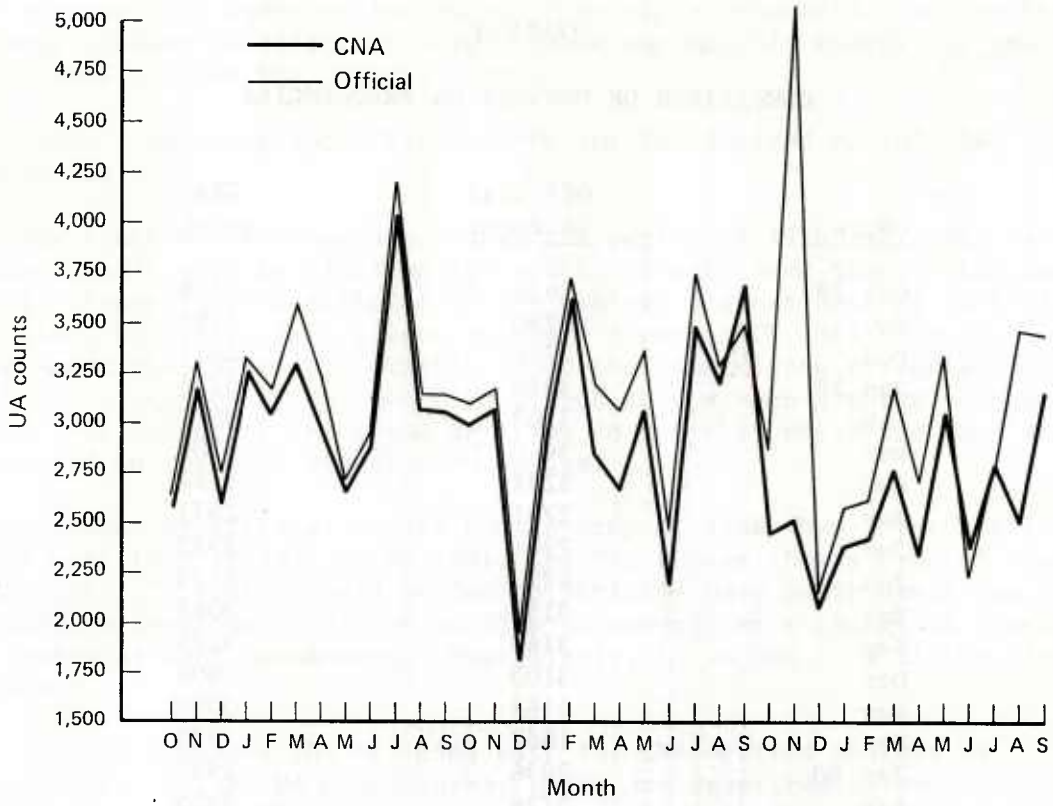

FIG. 1: MONTHLY UA COUNTS: FY1979-FY1981

TABLE 2

COMPARISON OF ANNUAL UA FREQUENCIES

			Ratios (percent)		
Year	Official count	CNA count	CNA/ official	Official/ FY 1979	CNA/ FY 1979
FY 1979	38,200	37,034	96.9	100.0	100.0
FY 1980	37,548	35,780	95.3	98.3	96.6
FY 1981	36,375	31,010	85.3	95.2	83.7

TABLE 3

COMPARISON OF MONTHLY DX FREQUENCIES

Date	Official DX count	CNA count
Oct 78	1494	1745
Nov	1118	1550
Dec	870	1335
Jan 79	956	1286
Feb	1116	1399
Mar	1160	1417
Apr	1245	1449
May	976	1202
Jun	823	1092
Jul	1650	1738
Aug	1118	1503
Sep	1026	1260
Oct	1638	1977
Nov	808	1013
Dec	925	1216
Jan 80	998	1233
Feb	899	1086
Mar	1077	1345
Apr	817	1058
May	961	1216
Jun	971	1166
Jul	1066	1315
Aug	1010	1223
Sep	961	1350
Oct	829	1078
Nov	991	966
Dec	619	1029
Jan 81	789	992
Feb	627	816
Mar	771	922
Apr	898	1105
May	971	1078
Jun	830	1003
Jul	893	1141
Aug	1065	1144
Sep	898	859

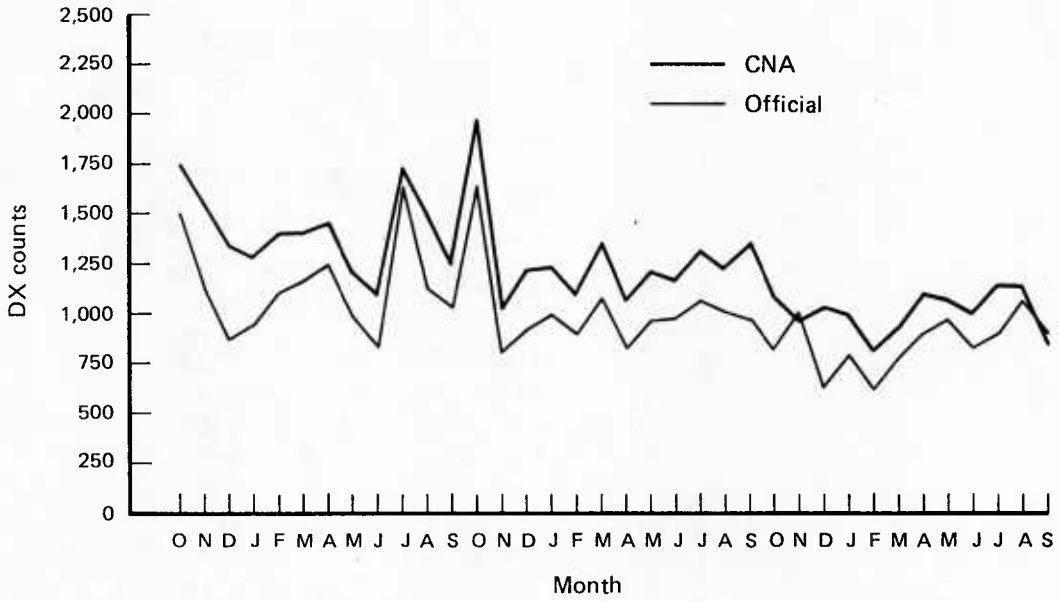

FIG. 2: MONTHLY DX COUNTS: FY1979-FY1981

TABLE 4

COMPARISON OF ANNUAL DX FREQUENCIES

Year	Official count	CNA count	Ratios (percent) Official/ CNA	Official/ FY 1979	CNA/ FY 1979
FY 1979	13,552	16,976	79.8	100.0	100.0
FY 1980	12,131	15,198	79.8	89.5	89.5
FY 1981	10,181	12,133	83.9	75.1	71.5

In order to reduce the enlisted population we need to consider for our analysis, we examine UA/DX rates for subgroups of the population defined by type of enlistment. We present UA rates for the FY 1979 cohort in table 5 and DX rates in table 6. These tables suggest that the Navy need only concern itself with Active Mariners and NPS males in their first enlistment. Although other-service veterans also have high UA/DX rates, there are two few of them to worry about.

Tables 7 and 8 give a further breakdown of UA/DX occurrences according to duty status when the incident occurred, and for DX incidents, table 9 shows the mode of return to custody.

Perhaps the most outstanding feature in table 7 is that a large percentage of UA incidents occur during initial skill training, i.e., Class "A" school or apprenticeship training. For Active Mariners, 15.1% of individuals with one or more UAs had at least one UA during initial skill training. The corresponding figure for NPS males is 23.9%. When matched against the EMRs and Student Master Files (SMFs), we were able to determine whether an incident occurred during apprenticeship training or "A" school. A breakdown is given in table 10. Note that the total number of UAs in this table do not add up exactly to the total number of UAs in table 7. This is due to the quarterly nature of the EMRs, which results in our picking up some transients (individuals who have completed initial skill training and are awaiting transfer to a permanent duty assignment) but classifying them as still in school (since the EMRs only record an individual's status at the beginning of the quarter). However, there are only 15 such individuals, so this should not be of much concern.

Table 7 suggests that separate analyses of UA behavior in Class "A" school and during permament duty are warranted. These analyses are presented in the next two sections. No further analysis of DX patterns is presented, however, due to monetary constraints.

TABLE 5

UA RATES BY TYPE OF ENLISTMENT

Type of enlistment	Number of UAs					
	0	≥ 1	≥ 2	≥ 3	≥ 4	≥ 5
Active Mariners	13,118 (79.4%)	3,405 (20.6%)	1,555 (9.4%)	801 (4.8%)	451 (2.7%)	277 (1.7%)
NPS Males - First Enlistment	45,341 (84.4%)	8,356 (15.6%)	3,591 (6.7%)	1,899 (3.5%)	1,049 (2.0%)	613 (1.1%)
NPS Males - Subsequent Enlistments	33,783 (98.8%)	419 (1.2%)	134 (0.4%)	57 (0.2%)	32 (0.1%)	17 (0.0%)
Prior Service - Navy	3,814 (92.5%)	310 (7.5%)	115 (2.8%)	55 (1.3%)	29 (0.7%)	20 (0.5%)
Prior Service - Other Services	1,936 (82.8%)	402 (17.2%)	178 (7.6%)	82 (3.5%)	52 (2.2%)	30 (1.3%)
Females	9,648 (94.8%)	528 (5.2%)	179 (1.8%)	85 (0.8%)	46 (0.5%)	21 (0.2%)

TABLE 6

DX RATES BY TYPE OF ENLISTMENT

Type of enlistment	Number of DXs			
	0	≥ 1	≥ 2	≥ 3
Active Mariners	14,747 (89.3%)	1,776 (10.7%)	567 (3.4%)	168 (1.0%)
NPS Males - First Enlistment	49,450 (92.1%)	4,247 (7.9%)	1,258 (2.3%)	345 (0.6%)
NPS Males - Subsequent Enlistments	34,025 (99.5%)	177 (0.5%)	39 (0.1%)	10 (0.0%)
Prior Service - Navy	3,951 (95.8%)	173 (4.2%)	60 (1.5%)	18 (0.4%)
Prior Service - Other Services	2,112 (90.3%)	226 (9.7%)	56 (2.4%)	14 (0.6%)
Females	9,942 (97.7%)	234 (2.3%)	34 (0.3%)	7 (0.0%)

TABLE 7

DISTRIBUTION OF UA INCIDENTS BY DUTY STATUS

Active Mariners

Duty status	UA Number 1	2	3	4	5
Sea duty	2,041 (59.9%)	1,005 (64.6%)	512 (63.9%)	283 (62.7%)	163 (58.8%)
Shore duty	1,140 (33.5%)	483 (31.1%)	254 (31.7%)	154 (34.1%)	108 (39.0%)
Other	224 (6.6%)	67 (4.3%)	35 (4.4%)	14 (3.1%)	6 (2.2%)
Permanent duty	2,399 (70.5%)	1,141 (73.4%)	577 (72.0%)	304 (67.4%)	174 (62.8%)
Skill training	515 (15.1%)	158 (10.2%)	71 (8.9%)	39 (8.6%)	24 (8.7%)
Temporary duty	362 (10.6%)	224 (14.4%)	133 (16.6%)	96 (21.3%)	68 (24.5%)
Boot camp	129 (3.8%)	32 (2.1%)	20 (2.5%)	12 (2.7%)	11 (4.0%)
Liberty	1,763 (51.9%)	756 (48.7%)	356 (44.5%)	183 (40.5%)	102 (36.8%)
Duty	1,426 (42.0%)	749 (48.2%)	426 (53.5%)	256 (56.7%)	168 (60.6%)
Leave	209 (6.1%)	48 (3.1%)	18 (2.2%)	12 (2.7%)	7 (2.5%)

NPS Males

Sea duty	4,171 (49.9%)	1,927 (53.7%)	1,035 (54.5%)	581 (55.4%)	319 (52.0%)
Shore duty	3,667 (43.9%)	1,471 (41.0%)	763 (40.2%)	425 (40.5%)	274 (44.7%)
Other	518 (6.2%)	193 (5.4%)	101 (5.3%)	43 (4.1%)	20 (3.3%)
Permanent duty	4,997 (59.8%)	2,247 (62.6%)	1,195 (62.9%)	657 (62.6%)	360 (58.7%)
Skill training	1,993 (23.9%)	617 (17.2%)	254 (13.4%)	121 (11.5%)	73 (11.9%)
Temporary duty	1,020 (12.2%)	592 (16.5%)	381 (20.1%)	246 (23.5%)	162 (26.4%)
Boot camp	287 (3.4%)	103 (2.9%)	51 (2.7%)	14 (1.3%)	12 (2.0%)
Liberty	4,122 (49.4%)	1,604 (44.7%)	793 (41.8%)	397 (37.9%)	224 (36.7%)
Duty	3,788 (45.4%)	1,852 (51.6%)	1,064 (56.1%)	638 (60.9%)	379 (62.0%)
Leave	433 (5.2%)	131 (3.7%)	39 (2.1%)	13 (1.2%)	8 (1.3%)

TABLE 8

DISTRIBUTION OF DX INCIDENTS BY DUTY STATUS

	Active Mariners		
	DX Number		
Duty station	1	2	3
Sea duty	964 (54.3%)	285 (50.3%)	69 (41.1%)
Shore duty	717 (40.4%)	269 (47.4%)	94 (56.0%)
Other	95 (5.3%)	13 (2.3%)	5 (3.0%)
Permanent duty	870 (49.0%)	208 (36.7%)	47 (28.0%)
Skill training	49 (2.8%)	6 (1.1%)	0 (0.0%)
Temporary duty	719 (40.5%)	325 (57.3%)	114 (67.9%)
Boot camp	137 (7.7%)	28 (4.9%)	7 (4.2%)
Liberty	517 (42.2%)	93 (30.7%)	17 (20.5%)
Duty	631 (51.5%)	201 (66.3%)	62 (74.7%)
Leave	78 (6.4%)	9 (3.0%)	4 (4.8%)
	NPS Males		
Sea duty	2,008 (47.3%)	561 (44.6%)	110 (31.9%)
Shore duty	2,044 (48.1%)	655 (52.1%)	225 (65.2%)
Other	195 (4.6%)	42 (3.3%)	10 (2.9%)
Permanent duty	1,746 (41.1%)	418 (33.2%)	81 (23.5%)
Skill training	133 (3.1%)	14 (1.1%)	2 (0.6%)
Temporary duty	1,932 (45.5%)	772 (61.4%)	250 (72.5%)
Boot camp	436 (10.3%)	54 (4.3%)	12 (3.5%)
Liberty	1,274 (44.3%)	194 (28.8%)	30 (17.4%)
Duty	1,467 (51.0%)	454 (67.5%)	138 (80.2%)
Leave	134 (4.7%)	25 (3.7%)	4 (2.3%)

TABLE 9

DISTRIBUTION OF DX INCIDENTS BY MODE OF RETURN TO CUSTODY

Mode of return	Active Mariners DX Number 1	Active Mariners DX Number 2	Active Mariners DX Number 3	NPS Males DX Number 1	NPS Males DX Number 2	NPS Males DX Number 3
Surrendered	372 (20.9%)	143 (25.2%)	34 (20.2%)	948 (22.3%)	298 (23.6%)	72 (20.9%)
Apprehended	798 (44.9%)	164 (28.9%)	38 (22.6%)	1,879 (44.2%)	383 (30.4%)	82 (23.8%)
Still at large	276 (15.6%)	145 (25.6%)	52 (31.0%)	730 (17.2%)	310 (24.7%)	111 (32.2%)
Returned (cannot determine mode)	330 (18.6%)	115 (20.3%)	44 (26.2%)	690 (16.3%)	267 (21.3%)	80 (23.2%)

TABLE 10

FREQUENCIES OF UA INCIDENTS DURING INITIAL SKILL TRAINING

School	Number of UAs			
	0	≥ 1	≥ 2	≥ 3
Apprenticeship Training	22,380 (99.3%)	158 (0.7%)	36 (0.0%)	16 (0.0%)
Class "A" School	45,277 (95.0%)	2,365 (5.0%)	759 (1.6%)	316 (0.7%)

UNAUTHORIZED ABSENCES IN CLASS "A" SCHOOL

This section presents the results of a preliminary analysis of UA behavior in the Navy's technical training, i.e., Class "A", schools. Data for the analysis were obtained by matching the ATRs against the EMRs for individuals with an active duty service date in FY 1979 to provide additional background information, and with the SMFs to provide school data. Then individuals with an active duty service date in FY 1979 but with no record of UA behavior in Class "A" school were added to the data base.

As was shown in the introduction, 15.1 percent of Active Mariners and 23.9 percent of NPS males had at least one UA while in post-RTC training, i.e., in apprenticeship training, "A" school, "C" school, or "F" school. Further, an examination of the SMFs show that the vast majority of these UA incidents occur during Class "A" school (the frequencies with which they occur were shown in table 10 of the introduction). The 2,365 individuals with at least one UA incident account for over 3,440 separate occurrences, an average of about 1.5 UAs per person.

We now explore the relationships between pre-service personnel characteristics and UA behavior in Class "A" school. We also examine UA patterns with respect to the rating group for which a recruit is training. The ratings which comprise each rating group are shown in table 11.

Table 12 gives the distribution of UA occurrences by rating group. It is clear from this table that personnel in the Hull group have by far the highest UA rate of any rating group. Nearly 8 percent of individuals in this group have at least one UA incident. Personnel in the Ordnance, Electronics, and Aviation rating groups also account for a relatively large number of UA incidents. On the other end of the scale is the Construction group which exhibits very little UA behavior.

The distributions of UA occurrences by pre-service personnel characteristics are shown in table 13. Table 13 shows clearly that education has the greatest impact on UA rates in Class "A" school. Other variables with a large influence on UA rates are age, entry status, and enlistment waivers. Personnel with a 5-year term of enlistment have very few UAs in Class "A" school, but these individuals account for only a small fraction of the enlisted population.

Although the overall chance of having at least one UA in Class "A" school is 5 percent, a look back at table 10 shows that once an individual goes UA, he is very likely to go again. Given one UA occurrence in the past, the probability of at least one more is 32.1 percent. If an individual has already had two UAs, the probability of a third is 41.6 percent. A breakdown of these conditional rates by personnel characteristics is given in table 14.

TABLE 11

RATING GROUP DEFINITIONS

Rating group	Individual ratings
Aviation	AB, AC, AD, AE, AG, AK, AM, AO, AQ, AS, AT, AW, AX, AZ, PH, PR, TD
Construction	BU, CE, CM, EA, SW, UT
Administrative	DK, DP, IS, JO, LN, MS, NC, PC, PN, RM, SH, SK, YN
Cryptology	CT
Hull	BT, EM, EN, HT, IC, ML, MM, MR, PM
Deck	BM, EW, MA, OS, OT, QM, SM, ST
Electronics	DS, ET, IM, OM
Ordnance	FT, GM, MN, MT, TM
Medical	DT, HM
Other	DM, LI, MU

TABLE 12

DISTRIBUTION OF UA OCCURRENCES BY RATING GROUP

Rating group	Number of UAs			
	0	≥ 1	≥ 2	≥ 3
Hull	12,570 (92.1%)	1,085 (7.9%)	386 (2.9%)	174 (1.3%)
Ordnance	3,318 (94.4%)	198 (5.6%)	58 (1.6%)	29 (0.8%)
Electronics	2,953 (94.6%)	168 (5.4%)	49 (1.6%)	15 (0.5%)
Aviation	10,632 (95.9%)	457 (4.1%)	128 (1.2%)	55 (0.5%)
Deck	3,585 (96.1%)	126 (3.9%)	53 (1.4%)	20 (0.5%)
Cryptology	891 (96.7%)	30 (3.3%)	10 (1.1%)	2 (0.2%)
Administrative	5,427 (97.2%)	157 (2.8%)	43 (0.7%)	13 (0.2%)
Medical	3,685 (97.3%)	101 (2.7%)	23 (0.6%)	4 (0.1%)
Construction	1,474 (98.7%)	19 (1.3%)	6 (0.4%)	3 (0.2%)
Other	55 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

TABLE 13

DISTRIBUTIONS OF UA OCCURRENCES BY
PRE-SERVICE PERSONNEL CHARACTERISTICS

Characteristic	Value	Number of UAs			
		0	≥ 1	≥ 2	≥ 3
Age	17	7,019 (92.0%)	613 (8.0%)	241 (3.2%)	111 (1.5%)
	18	17,734 (95.9%)	757 (4.1%)	231 (1.3%)	88 (0.5%)
	19	8,744 (95.4%)	420 (4.6%)	131 (1.4%)	58 (0.6%)
	20	4,176 (95.2%)	210 (4.8%)	61 (1.4%)	23 (0.5%)
	21	2,406 (94.9%)	130 (5.1%)	36 (1.4%)	16 (0.6%)
	22	1,610 (95.1%)	83 (4.9%)	18 (1.1%)	6 (0.4%)
	23	1,254 (96.5%)	46 (3.5%)	10 (0.7%)	3 (0.2%)
	24	816 (96.2%)	32 (3.8%)	10 (1.1%)	2 (0.2%)
	25+	1,516 (95.4%)	73 (4.6%)	20 (1.3%)	8 (0.5%)
Mental Group (renormed)	1	2,581 (96.0%)	108 (4.0%)	25 (1.0%)	10 (0.4%)
	2	16,725 (95.2%)	837 (4.8%)	264 (1.5%)	113 (0.6%)
	3U	11,115 (94.2%)	679 (5.8%)	227 (1.9%)	95 (0.8%)
	3L	7,788 (95.3%)	380 (4.7%)	119 (1.4%)	52 (0.6%)

TABLE 13 (Cont'd)

Characteristic	Value	Number of UAs			
		0	≥ 1	≥ 2	≥ 3
	4A	3,776 (95.4%)	184 (4.6%)	70 (1.8%)	27 (0.7%)
	4B	1,584 (95.9%)	68 (4.1%)	18 (1.1%)	6 (0.4%)
	4C-5	403 (94.8%)	22 (5.2%)	7 (1.6%)	1 (0.2%)
School Guarantee	No	6,291 (93.3%)	451 (6.7%)	142 (2.1%)	66 (1.0%)
	Yes	38,984 (95.3%)	1,914 (4.7%)	617 (1.5%)	250 (0.6%)
Education	NHSG	7,219 (89.4%)	858 (10.6%)	330 (4.1%)	147 (1.8%)
	GED	3,061 (91.4%)	287 (8.6%)	109 (3.3%)	52 (1.6%)
	HSDG	34,997 (96.6%)	1,220 (3.4%)	320 (0.9%)	117 (0.3%)
Entry Status	Direct	11,553 (91.9%)	1,023 (8.1%)	352 (2.8%)	162 (1.3%)
	Delayed	33,724 (96.2%)	1,342 (3.8%)	407 (1.1%)	154 (0.4%)
Race	White	37,722 (94.7%)	2,095 (5.3%)	686 (1.7%)	292 (0.7%)
	Non-White	7,555 (96.5%)	270 (3.5%)	73 (0.9%)	24 (0.3%)

TABLE 13 (Cont'd)

Characteristic	Value	Number of UAs 0	≥ 1	≥ 2	≥ 3
Term of Enlistment	3 years	8,140 (94.0%)	518 (6.0%)	165 (1.9%)	73 (0.8%)
	4 years	22,536 (95.0%)	1,189 (5.0%)	416 (1.7%)	175 (0.7%)
	5 years	2,186 (98.9%)	24 (1.1%)	7 (0.3%)	4 (0.2%)
	6 years	12,412 (95.1%)	634 (4.9%)	171 (1.3%)	64 (0.5%)
Enlistment Waiver	Major Misdemeanor	3,409 (91.8%)	303 (8.2%)	107 (2.8%)	50 (1.3%)
	Felony	450 (92.4%)	37 (7.6%)	12 (2.4%)	6 (1.2%)
	Minor Misdemeanor	762 (92.7%)	60 (7.3%)	26 (3.2%)	9 (1.1%)
	Drugs	3,670 (94.2%)	224 (5.8%)	73 (1.8%)	33 (0.8%)
	None	34,761 (95.5%)	1,643 (4.5%)	515 (1.4%)	210 (0.6%)
	Other	2,024 (95.7%)	92 (4.3%)	26 (1.3%)	8 (0.4%)
	SCREEN	201 (97.1%)	6 (2.9%)	0 (0.0%)	0 (0.0%)

TABLE 14

CONDITIONAL UA RATES BY PERSONNEL CHARACTERISTICS

Characteristic		Conditional rates[a] P(2|1)	P(3|2)
Rating Group	Deck	36.8%	37.7%
	Hull	35.6%	45.1%
	Ordnance	29.3%	50.0%
	Electronics	29.2%	30.6%
	Aviation	28.0%	43.0%
	Administrative	27.4%	30.2%
	Medical	22.8%	--[b]
Age	17	39.3%	46.1%
	18	30.5%	38.1%
	19	31.2%	44.3%
	20	29.0%	37.7%
	21+	25.8%	37.2%
Mental Group	1	23.1%	--[b]
	2	31.5%	42.8%
	3U	33.4%	41.9%
	3L	31.3%	43.7%
	4A-5	34.7%	35.8%
School Guarantee	Yes	32.2%	40.5%
	No	31.5%	46.5%
Education	NHSG	38.5%	44.5%
	GED	38.0%	47.7%
	HSDG	26.2%	36.6%
Entry Status	Direct	34.4%	46.0%
	Delayed	30.3%	37.8%
Race	White	32.7%	42.6%
	Non-White	27.0%	32.9%

TABLE 14 (Cont'd)

Characteristic		Conditional rates[a] P(2|1)	P(3|2)
Term of Enlistment	3 years	31.9%	44.2%
	4 years	35.0%	42.1%
	6 years	27.0%	37.4%
Enlistment Waiver	Crime	36.3%	44.8%
	Drugs	32.6%	45.2%
	None	31.3%	40.8%

[a]P(2|1) = probability of second UA given one already; P(3|2) = probability of a third UA given two already.
[b]Too few numbers to accurately compute percentage.

Table 14 shows wide differences in conditional UA rates but they are not always consistent. For instance, the Deck rating group has the highest value of $P(2|1)$, but the Ordnance group has the highest value of $P(3|2)$. Also, 3 YOs have a smaller chance of a second UA than 4 YOs, but have a larger chance of a third UA.

To more accurately assess the impact of pre-service characteristics on UA rates, it is necessary to perform a multivariate analysis. In particular, we employ a multivariate probit analysis (see, for example, [10]), a technique that has been used extensively in prior CNA studies.

Computer space limitations preclude considering every level of every variable examined in the previous section. Thus we consolidate some of the categories of certain variables, using the results of the descriptive analysis as a guide to group categories according to similar UA rates.

The analysis is performed in three steps --i.e., three probit analyses. The first analysis estimates the impact of characteristics on the probability of having one or more UAs, $P(1)$. Next, we apply another probit analysis to determine the impact of recruit characteristics on the conditional probability of having a second UA, given one previous UA occurrence, $P(2|1)$. The third probit analysis is applied similarly, to determine $P(3|2)$. Unconditional probabilities are then obtained by multiplication. For instance, the probability of two or more UAs is $P(2) = P(1)P(2|1)$ and the probability of three or more UAs is $P(3) = P(1)P(2|1)P(3|2)$.

Table 15 shows the coefficient estimates from the probit analysis for the chances of having at least one UA. The more negative a coefficient is, the lower will be the UA rate; the more positive a coefficient, the higher the UA rate.

The variable with the most adverse effect (positive coefficient) on UA rates is Rating Group; in particular, those in the Hull group have the highest rate. The variable with the most favorable effect (negative coefficient) is HSDG, i.e., having a high school diploma. If an individual enters the Navy via the Delayed Entry Program (DEP), this also implies a lower UA rate. Further, the presence of a significant DEP by education interaction implies a still lower UA rate if the individual is both a high school diploma graduate and has entered via the DEP.

Tables 16 and 17 give the coefficients for the conditional chances of having two and three UAs, respectively. Being in the Hull or the Deck group and being a high school diploma graduate are the only characteristics that have a significant influence on the probability of a second UA. For the third UA, Rating Group is the only variable that significantly affects this rate, i.e., the Ordnance, Hull, and Aviation groups (in that order) have significantly higher chances of a third UA than the remaining rating groups.

TABLE 15

COEFFICIENT ESTIMATES FROM THE PROBIT ANALYSIS
OF CHANCES OF HAVING AT LEAST ONE UA

Variable[a]	Coefficient	Standard deviation	X^2[b]
HULL	0.601	0.105	32.762
EL-ORD	0.467	0.107	19.049
AV-DEC	0.274	0.105	6.810
AD-CR-MD	0.110	0.106	1.077
CRIME	0.180	0.030	36.000
DRUGS	0.046	0.036	1.633
AGE17	0.104	0.027	14.837
MG3UxHS	0.066	0.047	1.972
MGRP3U	0.002	0.035	0.003
GUAR	-0.006	0.028	0.046
RACE	-0.087	0.031	7.876
DEPxHS	-0.128	0.043	8.861
DEP	-0.219	0.034	41.489
TERM3	0.009	0.027	0.111
TERM5	-0.224	0.091	6.059
GED	-0.084	0.038	4.886
HSDG	-0.415	0.040	107.641
Constant	-1.571	0.110	103.970

[a]AV-DEC = Aviation and Deck rating groups;
EL-ORD = Electronics and Ordnance rating groups;
AD-CR-MD = Administrative, Cryptology, and Medical rating groups;
MG3UxHS = mental group by education interaction;
DEP x HS = DEP by education interaction, all other variable names are self-explanatory.

[b]All chi-squared (X^2) values in this and subsequent tables have one degree of freedom. The five percent significance level of a X^2 distribution with one degree of freedom is 3.841. All X^2 values greater than 3.841 are considered significant.

TABLE 16

COEFFICIENT ESTIMATES FROM THE PROBIT ANALYSIS
OF CONDITIONAL CHANCES OF HAVING A SECOND UA

Variable	Coefficient	Standard deviation	X^2
HUL-DEC	0.332	0.156	4.529
AV-AD-EL-ORD	0.158	0.157	1.013
MG4A-C	0.247	0.169	2.136
MG2-3L	0.124	0.145	0.731
AGE17	0.199	0.119	2.796
AGE18-20	0.081	0.105	0.595
GUAR	0.142	0.077	3.401
CRIME	0.131	0.076	2.971
DRUGS	0.058	0.096	0.365
TERM4	0.115	0.073	2.482
TERM6	-0.024	0.096	0.063
DEP	-0.038	0.079	0.231
DEPxHS	-0.120	0.115	1.069
RACE	-0.160	0.095	2.837
GED	0.029	0.096	0.091
HSDG	-0.197	0.098	4.041
Constant	-0.981	0.238	16.990

TABLE 17

COEFFICIENT ESTIMATES FROM THE PROBIT ANALYSIS
OF CONDITIONAL CHANCES OF HAVING A THIRD UA

Variable	Coefficient	Standard deviation	X^2
ORD	1.111	0.395	7.911
HULL	0.926	0.361	6.579
AV	0.909	0.372	5.971
DECK	0.710	0.398	3.182
AD-EL	0.575	0.383	2.254
MG1-3L	0.247	0.159	2.413
GED	0.203	0.158	1.651
HSDG	-0.085	0.172	0.244
CRIME	0.131	0.125	1.098
DRUGS	0.088	0.165	0.284
DEPxHS	0.124	0.201	0.381
AGE19	0.107	0.162	0.436
AGE17	0.066	0.160	0.170
AGE18	-0.080	0.147	0.296
RACE	-0.063	0.182	0.120
GUAR	-0.145	0.133	1.189
TERM4	-0.085	0.126	0.455
TERM6	-0.155	0.175	0.784
DEP	-0.195	0.126	2.395
Constant	-1.041	0.429	5.888

From tables 15, 16, and 17 we can compute, for an individual with any given set of characteristics, the probabilities of having more than one, two, and three UA incidents. Since every combination of personnel characteristics would involve over 100,000 cell entries, it is clearly impossible to tabulate them here. We shall, instead, present a best case, worst case, and two "typical" case scenarios (the two typical cases differ only in educational level). These are defined below.

Best case	Worst case	Typical case 1	Typical case 2
Construction group	Hull group	Hull group	Hull group
Age 21+	Age 17	Age 18	Age 18
MGRP 1	MGRP 4	MGRP 2	MGRP 2
Sch. guar.	No sch. guar.	Sch. guar.	Sch. guar.
HSDG	NHSG	HSDG	NHSG
Delayed entry	Direct entry	Delayed entry	Delayed entry
Non-white	White	White	White
5 YO	3 YO	4 YO	4 YO
No waivers	Crime waivers	No waivers	No waivers

The UA probabilities for these groups are shown in table 18. A formula is presented in appendix A to allow the computation of these probabilities for any given combination of personnel characteristics.

TABLE 18

UA PROBABILITIES FOR FOUR DIFFERENT SCENARIOS

Scenario	Number of UAs			
	0	$\geq$ 1	$\geq$ 2	$\geq$ 3
Best	99.6%	0.4%	0.0%	0.0%
Worst	75.1%	24.9%	11.7%	6.3%
Typical 1	95.9%	4.1%	1.1%	0.4%
Typical 2	88.4%	11.6%	4.4%	1.5%

UNAUTHORIZED ABSENCES DURING PERMANENT DUTY

This section provides the results of three types of analysis. First, we list single characteristics of individuals and the associated probabilities of having a given number of UA occurrences. Next, we show how time of service affects UA rates. Then, we indicate how individual characteristics and time of service interact to determine the UA behavior of a given person over time. Thus, although the single-characteristic summaries are useful for a general understanding of UA occurrences, the most reliable predictors of UA behavior are found by looking at the interactions of personnel and unit characteristics.

Audit Trail Reports show that the large majority of UA offenses are committed during permanent duty assignment. Strictly speaking, this section considers UA incidents which occur any time after the first permanent duty assignment, i.e., during permanent or temporary duty. For convenience, however, we shall refer to any incident which occurs during either of these two periods as occurring during permanent duty.

Table 19 gives the distribution of UA occurrences for "A" school graduates by rating group.

Personnel in the Administrative, Hull, and Deck groups have by far the highest UA rates during permanent duty. Those in the Electronics and Cryptology groups have the lowest rate.

The distribution of UA occurrences for general apprenticeships is shown in table 20.

Overall, non-designated personnel have much higher UA rates than designated strikers or rated individuals. The figures for Seamen, Airmen, and Firemen are 22.1 percent, 18.1 percent, and 24 percent, respectively. In particular, those who have attended "A" school and failed, then returned to the fleet as general detail personnel, have by far the highest UA rates.

The distributions of UA occurrences by pre- and in-service personnel characteristics are shown in table 21.

Not surprisingly, the best predictor of UA behavior during permanent duty is a previous UA history, i.e., one or more UAs in boot camp or initial skill training. Those with a previous UA history have almost a 40-percent chance of going UA again. Education, age, and pay grade also have enormous impacts on subsequent UA behavior. For instance, a 17-year-old at the time of duty has a 20 percent higher chance of a future UA incident than does a 19-year-old. A non-high-school-diploma graduate has a 20 percent higher chance of going UA than a high-school-diploma graduate and an individual starting permanent duty as an E-1 is 17 percent more likely to have a subsequent UA than one starting as an

E-4. Variables with lesser, albeit still large, effects are school guarantee, entry status, term of enlistment, enlistment waivers, location, and unit type. Personnel on carriers and amphibious ships have a UA rate which is more than 10-percent higher than those on submarines and in air units. Mental group has a moderate impact for those in the upper two categories. The only variable which has no effect on UA rates is race.

TABLE 19

DISTRIBUTION OF UA OCCURRENCES DURING PERMANENT DUTY BY RATING GROUP

Rating Group	Number of UAs			
	0	≥ 1	≥ 2	≥ 3
Administrative	3,880 (86.4%)	609 (13.6%)	258 (5.7%)	109 (2.4%)
Hull	8,941 (88.5%)	1,164 (11.5%)	410 (4.1%)	170 (1.7%)
Deck	2,665 (88.6%)	343 (11.4%)	121 (4.0%)	51 (1.7%)
Medical	2,724 (93.4%)	192 (6.6%)	65 (2.2%)	32 (1.1%)
Aviation	7,668 (93.5%)	531 (6.5%)	195 (2.4%)	83 (1.0%)
Construction	1,248 (94.3%)	76 (5.7%)	31 (2.3%)	15 (1.1%)
Ordnance	2,100 (95.0%)	110 (5.0%)	34 (1.5%)	13 (0.6%)
Other	44 (97.8%)	1 (2.2%)	1 (2.2%)	1 (2.2%)
Electronics	1,812 (98.1%)	35 (1.9%)	10 (0.5%)	5 (0.3%)
Cryptology	578 (98.3%)	10 (1.7%)	2 (0.3%)	1 (0.2%)

TABLE 20

DISTRIBUTION OF UA OCCURRENCES DURING PERMANENT DUTY
BY APPRENTICESHIP GROUP

Apprenticeship Group	Number of UAs			
	0	≥ 1	≥ 2	≥ 3
Seaman - No "A" School	6,700 (79.8%)	1,695 (20.2%)	721 (8.6%)	370 (4.4%)
Seaman - "A" School Attrite	2,764 (73.8%)	983 (26.2%)	463 (12.4%)	241 (6.4%)
Airman - No "A" School	2,777 (84.8%)	496 (15.2%)	208 (6.4%)	109 (3.3%)
Airman - "A" School Attrite	1,487 (76.8%)	448 (23.2%)	229 (11.8%)	129 (6.7%)
Fireman - No "A" School	3,127 (78.7%)	848 (21.3%)	369 (9.3%)	170 (4.3%)
Fireman - "A" School Attrite	1,388 (70.5%)	581 (29.5%)	295 (15.0%)	144 (7.3%)

A thorough analysis of UA patterns cannot ignore time of service. We have partially circumvented this problem by looking at a cohort of individuals, but the problem of early attritions remains. Since the descriptive measures provided in the preceding few tables do not take time of service into account, they do not provide a complete picture of the patterns of UA behavior. In fact, they can occasionally be misleading, especially when small differences are involved. This is because early attriters are often counted as not having a UA (they have had less opportunity to go UA since their time of service is so short). Thus a thorough analysis must take time of service into account.

TABLE 21

DISTRIBUTIONS OF UA OCCURRENCES DURING PERMANENT DUTY
BY PERSONNEL CHARACTERISTICS

Characteristic	Value	Number of UAs			
		0	≥ 1	≥ 2	≥ 3
Previous UA History	Yes	1,255 (62.2%)	764 (37.8%)	420 (20.8%)	226 (11.2%)
	No	49,656 (87.0%)	7,448 (13.0%)	3,026 (5.3%)	1,430 (2.5%)
Age at Duty	17	2,544 (67.4%)	1,229 (32.6%)	592 (15.7%)	318 (8.4%)
	18	12,946 (83.5%)	2,567 (16.5%)	1,113 (7.2%)	531 (3.4%)
	19	15,396 (87.9%)	2,110 (12.1%)	828 (4.7%)	399 (2.3%)
	20	8,047 (89.4%)	951 (10.6%)	383 (4.3%)	166 (1.8%)
	21	3,896 (88.6%)	500 (11.4%)	193 (4.4%)	89 (2.9%)
	22	2,303 (88.8%)	291 (11.2%)	115 (4.4%)	50 (1.9%)
	23	1,617 (90.4%)	171 (9.6%)	67 (3.7%)	31 (1.7%)
	24	1,155 (91.8%)	103 (8.2%)	41 (3.3%)	21 (1.7%)
	25+	2,071 (90.8%)	211 (9.2%)	83 (3.6%)	35 (1.5%)

TABLE 21 (Cont'd)

Characteristic	Value	Number of UAs			
		0	≥ 1	≥ 2	≥ 3
Mental Group	1	2,182 (93.1%)	162 (6.9%)	54 (2.3%)	22 (0.9%)
	2	15,593 (89.0%)	1,919 (11.0%)	776 (4.4%)	357 (2.0%)
	3U	11,987 (83.4%)	2,388 (16.6%)	1,085 (7.5%)	539 (3.7%)
	3L	9,403 (84.2%)	1,771 (15.8%)	741 (6.6%)	361 (3.2%)
	4A	5,739 (84.8%)	1,771 (15.2%)	432 (6.4%)	220 (3.3%)
	4B	3.401 (86.8%)	519 (13.2%)	190 (4.8%)	83 (2.1%)
	4C-5	1,194 (85.3%)	205 (14.7%)	71 (5.1%)	30 (2.1%)
Pay Grade at Duty	E-1	18,120 (79.4%)	4,713 (20.6%)	2,111 (9.2%)	1,045 (4.6%)
	E-2	17,989 (87.5%)	2,577 (12.5%)	1,019 (5.0%)	477 (2.3%)
	E-3	6,770 (91.9%)	599 (8.1%)	214 (2.9%)	94 (1.3%)
	E-4	7,095 (96.7%)	245 (3.3%)	72 (1.0%)	26 (0.4%)
School Guarantee	No	15,390 (80.2%)	3,809 (19.8%)	1,668 (8.7%)	824 (4.3%)
	Yes	35,513 (89.0%)	4,401 (11.0%)	1,777 (4.5%)	831 (2.1%)

TABLE 21 (Cont'd)

Characteristic	Value	Number of UAs 0	≥ 1	≥ 2	≥ 3
Education	NHSG	8,184 (71.4%)	3,273 (28.6%)	1,600 (14.0%)	815 (7.1%)
	GED	2,857 (76.9%)	858 (23.1%)	381 (10.3%)	198 (5.3%)
	HSDG	39,870 (90.7%)	4,081 (9.3%)	1,465 (3.3%)	643 (1.5%)
Entry Status	Direct	14,976 (80.0%)	3,753 (20.0%)	1,671 (8.9%)	839 (4.5%)
	Delayed	35,935 (89.0%)	4,459 (11.0%)	1,775 (4.4)	817 (2.0%)
Race	White	40,696 (85.9%)	6,682 (14.1%)	2,826 (6.0%)	1,364 (2.9%)
	Non-White	10,215 (87.0%)	1,530 (13.0%)	620 (5.3%)	292 (2.5%)
Term of Enlistment	3 Years	10,991 (81.7%)	2,461 (18.3%)	1,105 (8.2%)	530 (3.9%)
	4 Years	27,631 (85.2%)	4,796 (14.8%)	1,996 (6.2%)	961 (3.0%)
	5 Years	2,007 (93.9%)	130 (6.1%)	52 (2.4%)	25 (1.2%)
	6 Years	10,278 (92.6%)	824 (7.4%)	292 (2.6%)	139 (1.3%)

TABLE 21 (Cont'd)

Characteristic	Value	Number of UAs 0	≥ 1	≥ 2	≥ 3
Enlistment Waiver	Felony	460 (76.7%)	140 (23.3%)	70 (11.7%)	38 (6.3%)
	Major Misdemeanor	3,707 (78.0%)	1,044 (22.0%)	478 (10.1%)	230 (4.8%)
	Minor Misdemeanor	832 (82.8%)	173 (17.2%)	91 (9.1%)	54 (5.4%)
	Drugs	3,987 (83.3%)	800 (16.7%)	311 (6.5%)	146 (3.0%)
	Other	2,170 (86.5%)	340 (13.5%)	136 (5.4%)	60 (2.4%)
	None	39,596 (87.4%)	5,694 (12.6%)	2,354 (5.2%)	1,125 (2.5%)
	Screen	159 (88.3%)	21 (11.7%)	6 (3.3%)	3 (1.7%)
Unit Type	Amphibious	3,783 (79.1%)	1,001 (20.9%)	410 (8.6%)	198 (4.1%)
	Carrier	5,040 (79.9%)	1,265 (20.1%)	627 (9.9%)	348 (5.5%)
	Support-Underway Replenishment	6,140 (82.7%)	1,285 (17.3%)	534 (7.2%)	246 (3.3%)
	Cruiser-Destroyer	8,467 (84.5%)	1,556 (15.5%)	609 (6.1%)	273 (2.7%)
	General Duty	8,629 (89.0%)	1,293 (13.0%)	551 (5.6%)	270 (2.7%)

TABLE 21 (Cont'd)

Characteristic	Value	Number of UAs			
		0	≥ 1	≥ 2	≥ 3
Unit Type-- (Cont.)	Submarine	2,786 (91.1%)	273 (8.9%)	98 (3.2%)	39 (1.3%)
	Other	8,169 (91.2%)	792 (8.8%)	325 (3.6%)	146 (1.6%)
	Air	6,927 (91.3%)	664 (8.7%)	260 (3.4%)	120 (1.6%)
Location	CONUS	41,513 (84.8%)	7,456 (15.2%)	3,190 (6.5%)	1,530 (3.1%)
	Non-CONUS	9,398 (92.6%)	756 (7.4%)	256 (2.5%)	126 (1.2%)

A method which takes time of service into account is the Cox regression model. This model also allows us to assess the simultaneous impact of personnel characteristics on UA behavior over time. By running the model first on the entire cohort, then on those with one or more UAs, two or more UAs, etc., we can estimate the distributions of times between successive UA occurrences. The ultimate outcomes of interest, however, are the probabilities of having k UAs (k = 0,1,2,...) as a function of time. The model which we employ to translate the interoccurrence distributions from the Cox model to the UA probabilities of interest is called a "generalized Markov birth process" (GMB process). The reason for choosing the GMB process, which is not the simplest model we could have chosen, is that it does not require the common assumptions that successive UA interoccurrence times be independent and that the number of UA occurrences in disjoint time intervals be independent. We strongly suspect these assumptions to be false.

Computer space and time limitations preclude considering every level of every variable shown in tables 19-21. Thus we consolidate some of the categories of certain variables, using the results of the descriptive analysis as a guide to group categories according to similar UA rates.

Tables 22-24 show the coefficient estimates from the Cox regression analysis of times to the first through third UA, respectively. The more negative a coefficient is, the longer the interoccurrence time; the more positive a coefficient, the shorter the interoccurrence time. The base group used for comparison is shown under each table. The coefficients shown in each table should be compared to zero values for the base group.

The estimates in table 22 were obtained from a simple random sample of 15,000 individuals from the FY 1979 cohort. It was necessary to sample because of computer space limitations. However, 15,000 individuals are more than enough to obtain accurate estimates. The estimates in all other tables were obtained without sampling.

An examination of the coefficients in table 22 shows that the most important variables for predicting the first UA during permanent duty are education, previous UA history, rating group, and pay grade. The coefficients indicate that GEDs and non-high-school-diploma graduates have approximately the same chance of committing a UA offense, each being far more likely to go UA than a high-school-diploma graduate. Similarly, Seamen and Firemen have the highest UA rates (especially those who failed to complete "A" school) whereas those in the Ordnance group have the lowest. Individuals in Administrative ratings have the highest UA rate among rated personnel.

TABLE 22

COX REGRESSION ANALYSIS OF TIME TO FIRST UA
DURING PERMANENT DUTY

Variable[a]	Coefficient	Standard Deviation	X^{2}[b]
GED	0.765	0.080	91.653
NHSG	0.755	0.058	166.538
PREVUA	0.750	0.092	66.618
SMN-A	0.631	0.092	46.771
SMN-NA	0.206	0.086	5.778
FMN-A	0.412	0.113	13.377
FMN-NA	0.224	0.097	5.273
AMN-A	0.179	0.130	1.883
AMN-NA	0.032	0.117	0.075
ADMIN	0.132	0.097	1.859
AV-MED	-0.276	0.101	7.482
CONST	-0.375	0.232	2.606
ORDN	-0.670	0.220	9.239
LOCAT	0.521	0.080	42.850
CRIME	0.473	0.061	60.189
DRUGS	0.195	0.079	6.096
AGE17	0.450	0.073	37.522
AGE18	0.137	0.054	6.546
TERM4	0.004	0.053	0.007
TERM5-6	0.197	0.114	2.948
CAR-AMP	0.125	0.059	4.439
GENDUTY	-0.125	0.074	2.851
SUB-AIR-OTH	-0.324	0.074	19.216
MGRP2	-0.045	0.173	0.068
MGRP3-4A	0.021	0.173	0.014
MGRP4B-5	-0.044	0.190	0.054
RACE	0.003	0.062	0.003
GUAR	-0.132	0.063	4.360
DEP	-0.276	0.048	32.954
PGE-2	-0.310	0.053	34.491
PGE-3	-0.552	0.110	25.020
PGE-4	-0.751	0.170	19.585

[a]PREVUA = previous UA, SMN-A = Seaman--"A" school attrite, SMN-NA = Seaman--no "A" school, FMN = Fireman, AMN = Airman, AV-MED = Aviation and Medical rating groups, TERM5-6 = 5- and 6-year obligors, CAR-AMP = Carriers + Amphibious, SUB-AIR-OTH = Submarines + Air + other, DEP = delayed entry program. Base group = high school diploma graduate, no previous UAs, Hull and Deck groups, non-CONUS, no waivers, age 19 and above, 3-year obligor, Support ship or Cruiser, Mental Group 1, white, no school guarantee, direct entry, pay grade E-1.

[b]All chi-squared (X^{2}) values in this and subsequent tables have one degree of freedom. The 5-percent significance level of an X^{2} distribution with one degree of freedom is 3.841. All X^{2} values greater than 3.841 are considered significant.

TABLE 23

COX REGRESSION ANALYSIS OF TIME TO SECOND UA
DURING PERMANENT DUTY

Variable[a]	Coefficient	Standard Deviation	X^2
SMN-A	0.336	0.068	24.239
SMN-NA	0.206	0.069	8.801
ANFN-A	0.281	0.067	17.677
ANFN-NA	0.161	0.070	5.222
ADMIN	0.221	0.079	7.905
AVIAT	0.106	0.087	1.496
MED	0.093	0.136	0.469
ORDN	-0.054	0.189	0.083
PREVUA	0.320	0.058	30.500
CARR	0.250	0.051	24.428
SUP-AM-GD	0.032	0.042	0.587
SUB	-0.125	0.109	1.313
NHSG	0.249	0.045	30.663
GED	0.188	0.062	9.232
CRIME	0.162	0.046	12.195
DRUGS	-0.097	0.061	2.492
LOCAT	0.127	0.072	3.117
AGE17	0.082	0.055	2.274
AGE18	0.064	0.041	2.396
MGRP2	-0.008	0.148	0.003
MGRP3U	0.035	0.150	0.054
MGRP3L-4A	-0.018	0.151	0.015
MGRP4B-5	-0.136	0.163	0.694
RACE	0.024	0.049	0.250
GUAR	0.004	0.048	0.006
TERM4-5	-0.001	0.039	0.000
TERM6	-0.021	0.103	0.040
DEP	-0.068	0.036	3.559
PGE-2	-0.109	0.041	6.992
PGE-3	-0.126	0.098	1.647
PGE-4	0.014	0.159	0.008

[a]ANFN = Airmen and Firemen; SUP-AM-GD = Support + Amphibious + General Duty; Base group = Hull and Deck groups, no previous UAs, Cruise or Air or Other, high school diploma graduate, no waivers, non-CONUS, age 19 and above, Mental Group 1, white, no school guarantee, 3-year obligor, direct entry, pay grade E-1.

TABLE 24

COX REGRESSION ANALYSIS OF TIME TO THIRD UA
DURING PERMANENT DUTY

Variable[a]	Coefficient	Standard Deviation	X^2
MED	0.495	0.199	6.206
ORDN	-0.154	0.307	0.253
AMN-A	0.307	0.108	8.025
AMN-NA	0.259	0.121	4.568
SMN-A	0.228	0.088	6.742
SMN-NA	0.214	0.089	5.811
FMN-A	0.136	0.103	1.454
FMN-NA	0.124	0.105	1.675
MGRP2	0.255	0.238	1.148
MGRP3-4A	0.367	0.239	2.361
MGRP4B-5	0.210	0.259	0.659
TERM6	0.365	0.137	7.139
AGE17	0.270	0.088	9.483
AGE18-19	0.123	0.066	3.496
CARR	0.218	0.085	6.598
AM-GD	0.044	0.080	0.308
SUP-AIR	-0.019	0.083	0.054
SUB-OTH	-0.208	0.119	3.078
GED	0.150	0.086	3.035
NHSG	0.060	0.064	0.874
PREVUA	0.142	0.080	3.148
CRIME	0.133	0.067	3.994
DRUGS	-0.039	0.090	0.193
GUAR	0.048	0.070	0.473
RACE	0.010	0.071	0.019
DEP	-0.091	0.052	3.029
LOCAT	-0.269	0.105	6.577
PGE-2	-0.023	0.059	0.148
PGE-3	-0.246	0.142	3.012
PGE-4	-0.309	0.257	1.448

[a]AM-GD = Amphibious + General Duty, SUP-AIR = Support + Air, SUB-OTH = Submarine + Other. Base group = Administrative + Hull + Deck + Aviation rating groups, Mental Group 1, 3 and 4 and 5-year obligors, age 20 and above, Cruiser, high school diploma graduate, no previous UAs, no waivers, no school guarantee, white, direct entry, non-CONUS, pay grade E-1.

In some cases, the multivariate analysis gives results that are different from the descriptive analysis. As previously explained, this is because the multivariate analysis takes time of service into account. As an example, consider term of enlistment. The descriptive analysis shows a decreasing trend in UA rates as term of enlistment increases. The multivariate analysis, on the other hand, shows a slight increasing trend (although not enough to be significant).

Table 25 summarizes the significant variables from the three regressions. Not unexpectedly, fewer personnel characteristics affect UA rates as the number of UAs increases. Almost 65 percent of the variables we considered were significant for predicting the first UA, although to varying degrees. Significant variables for all three regressions were apprenticeship group, enlistment waiver, and unit type. This indicates that personnel with the highest propensity for multiple UA occurrences are Seamen, those with crime waivers, and those assigned to Carriers.

TABLE 25

SIGNIFICANT VARIABLES FROM THE THREE REGRESSIONS OF TIME TO UA OCCURRENCE

First UA	Second UA	Third UA
GED	GED	SMN-A
NHSG	NHSG	SMN-NA
PREVUA	PREVUA	AMN-A
SMN-A	SMN-A	AMN-NA
SMN-NA	SMN-NA	MED
FMN-A	ANFN-A	LOCAT
FMN-NA	ANFN-NA	CRIME
AV-MED	ADMIN	AGE17
ORDN	CRIME	TERM6
LOCAT	CARR	CARR
CRIME	PGE-2	
DRUGS		
AGE17		
AGE18		
CAR-AMP		
SUB-AIR-OTH		
GUAR		
DEP		
PGE-2		
PGE-3		
PGE-4		

Having estimated the coefficients and hazard rates (the hazard rates are not presented here) from the Cox regression model, we can now compute UA probabilities from the GMB process. Although the process is straightforward, there are far too many combinations of variables to compute probabilities for each. We have therefore computed probabilities for the twelve "typical" cases defined in table 26.

Figures 3-14 plot UA probabilities as a function of time for cases 1-12, respectively. Thirty months was chosen as a reasonable time frame, allowing six months to begin permanent duty. As a summary, figure 15 plots the expected number of UAs for each case on one graph. It also provides an ordering of the twelve cases from best to worst. Case 10 is clearly the worst in terms of highest expected number of UAs. Although Seamen who became GENDETs due to having failed "A" school have much higher overall UA rates than regular Seamen (i.e., never having attended "A" school), the worst case involves regular Seamen. This is because apprenticeship group is not being viewed in isolation, as in the descriptive analysis, nor is it being examined while holding all other variables constant, as in the regression analyses. Rather, it is the combination of variables in case 10 that make it the worst case (among the 12 cases), especially the combination of no high school diploma, direct entry, and no school guarantee.

To this point, we have only discussed UA behavior in the context of when UA incidents are most likely to occur. The remainder of this section is devoted to a descriptive analysis of the length of UA occurrences. Overall, the average UA lengths and standard deviations (in parentheses) are 8.7 (8.1) days, 8.5 (8.1) days, and 8.2 (7.7) days, for the first, second, and third UAs, respectively. A breakdown of these figures by rating group is given in table 27 and by apprenticeship group in table 28.

A comparison of table 19 with table 27 shows an almost inverse relationship between UA rates and the length of the first UA occurrence across rating groups, i.e., those rating groups with the lowest UA rates tend to have the longest UA lengths. However, there is no consistent pattern across subsequent UA occurrences. Among apprenticeship groups, on the other hand, a comparison of table 20 with table 28 shows a direct relationship between UA rates and occurrence lengths. Furthermore, the lengths of the third UA occurrence are slightly shorter than those of the first two.

The means and standard deviations of UA occurrence lengths by personnel and unit characteristics are shown in table 29.

TABLE 26

"TYPICAL" CASES

Characteristic	1	2	3	4	5	6	7	8	9	10	11	12
Previous UA	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Rating group	Admin.	Admin.	Ordn.	Ordn.	Admin.	Admin.	Ordn.	Ordn.	SMN-NA	SMN-NA	SMN-A	SMN-A
Age	19	19	19	19	19	19	19	19	19	19	19	19
Mental group	2	2	2	2	2	2	2	2	3L	3L	2	2
Pay grade	E-2	E-1	E-2	E-1	E-2	E-1	E-2	E-1	E-1	E-1	E-1	E-1
Education	HSDG	HSDG	HSDG	HSDG	HSDG	HSDG	HSDG	HSDG	NHSG	NHSG	HSDG	HSDG
Term	4	4	4	4	4	4	4	4	4	4	4	4
Waivers	None	None	None	None	None	None	None	None	None	None	None	None
Unit type	Carrier	Carrier	Carrier	Carrier	Sub	Sub	Sub	Sub	Carrier	Carrier	Carrier	Carrier
School guar.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Entry	Delayed	Delayed	Delayed	Delayed	Delayed	Delayed	Delayed	Delayed	Direct	Direct	Delayed	Delayed
Race	White	White	White	White	White	White	White	White	White	White	White	White
Location	CONUS	CONUS	CONUS	CONUS	CONUS	CONUS	CONUS	CONUS	CONUS	CONUS	CONUS	CONUS

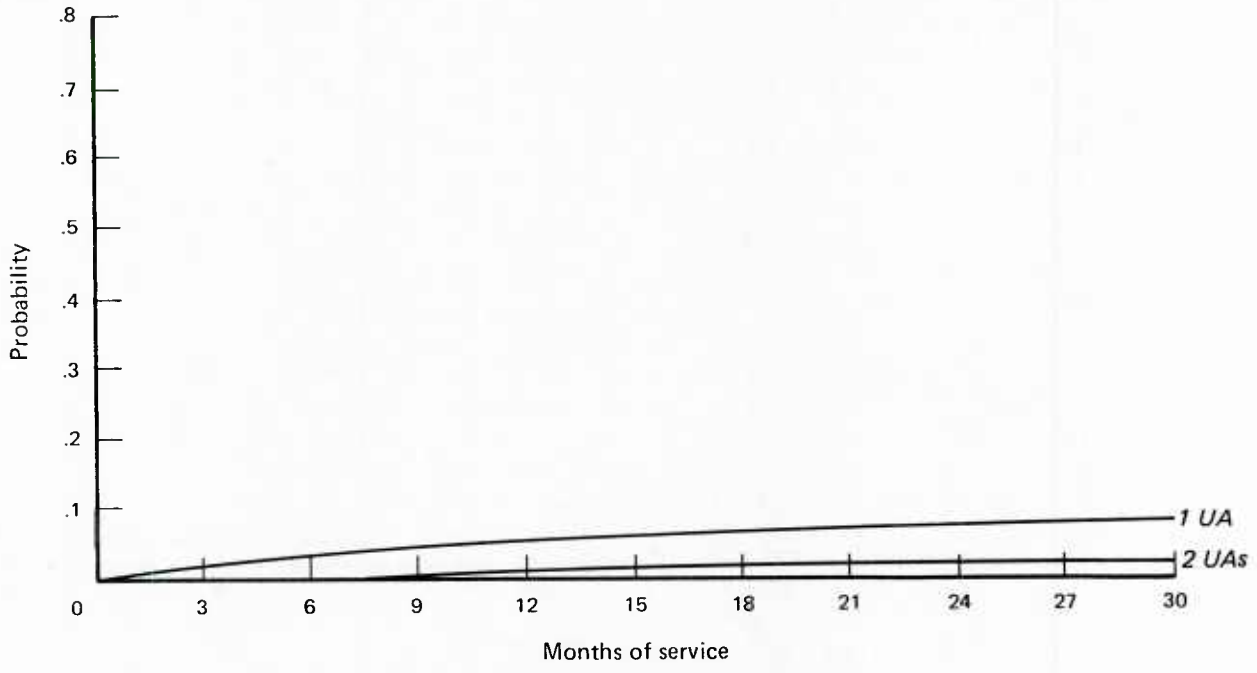

FIG. 3: UA PROBABILITIES FOR CASE 1

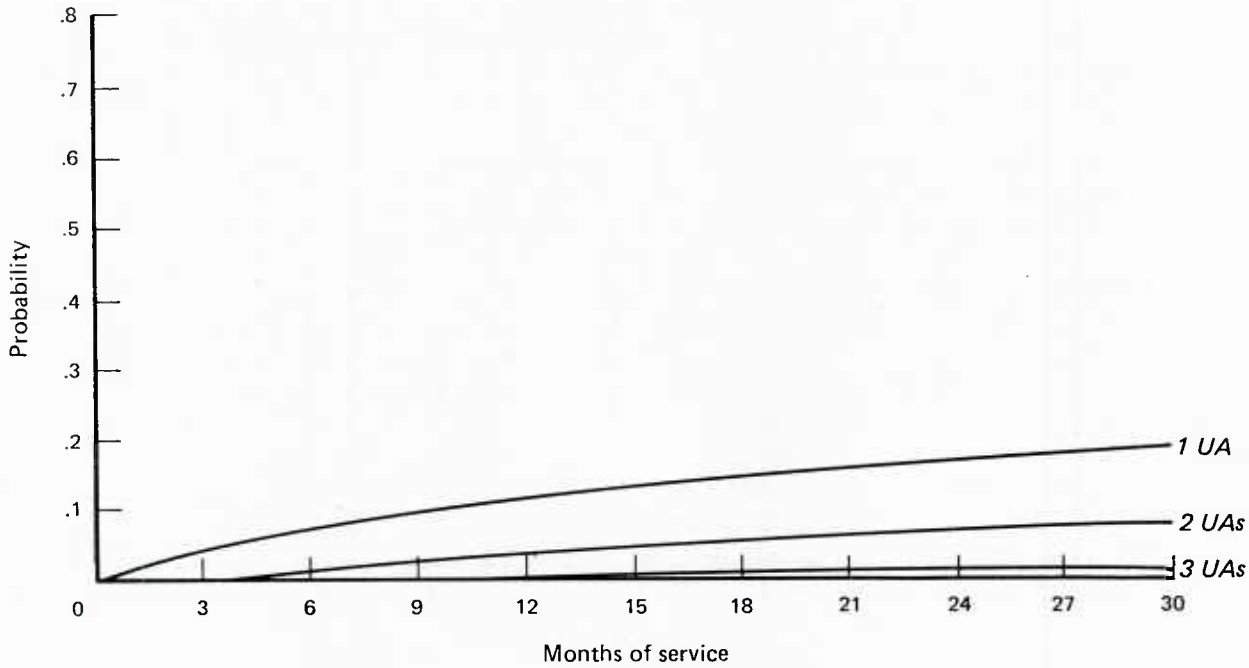

FIG. 4: UA PROBABILITIES FOR CASE 2

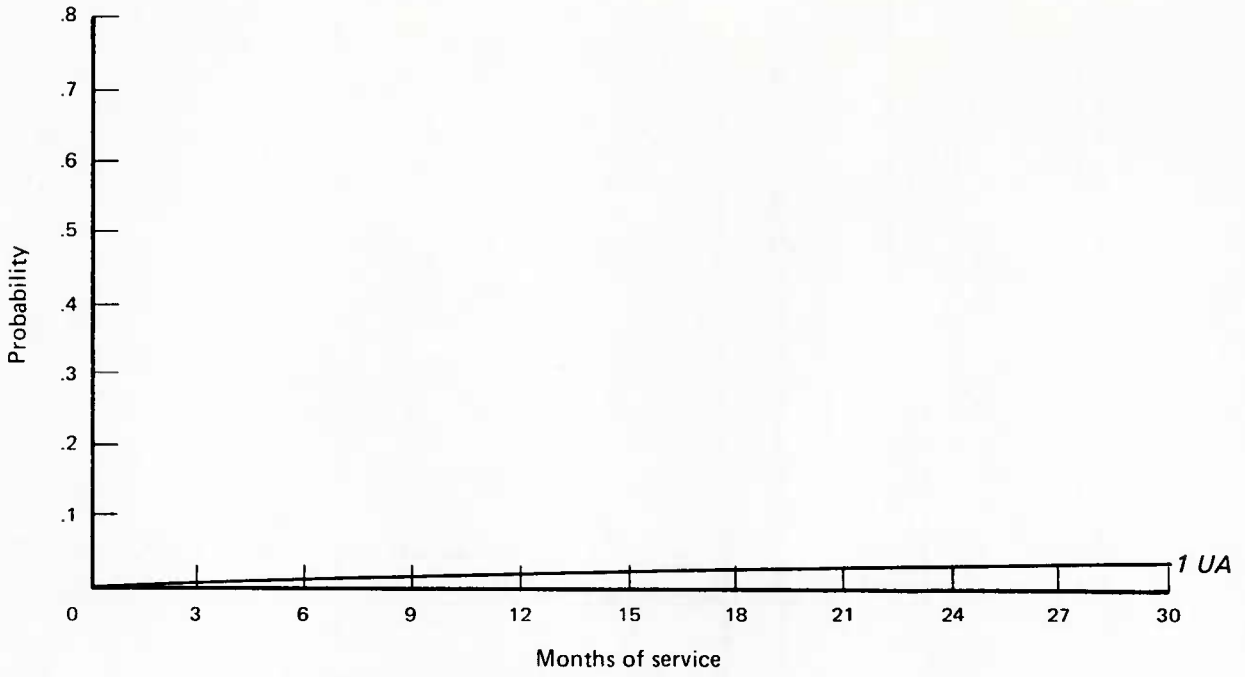

FIG. 5: UA PROBABILITIES FOR CASE 3

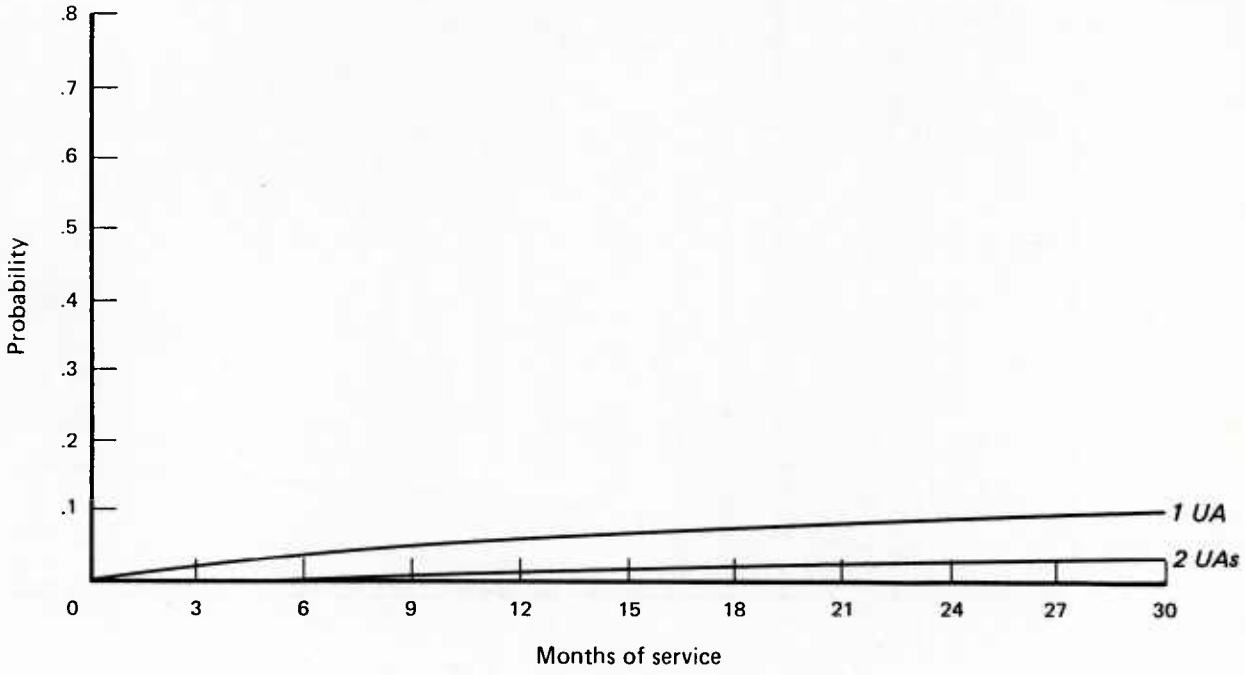

FIG. 6: UA PROBABILITIES FOR CASE 4

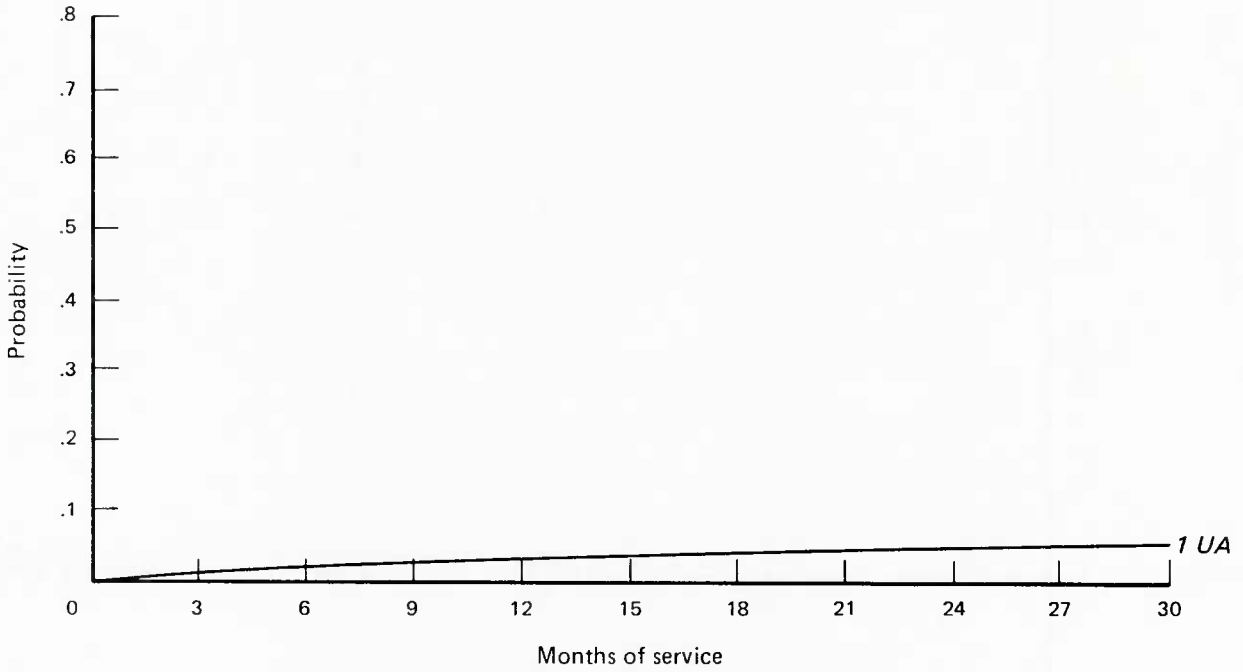

FIG. 7: UA PROBABILITIES FOR CASE 5

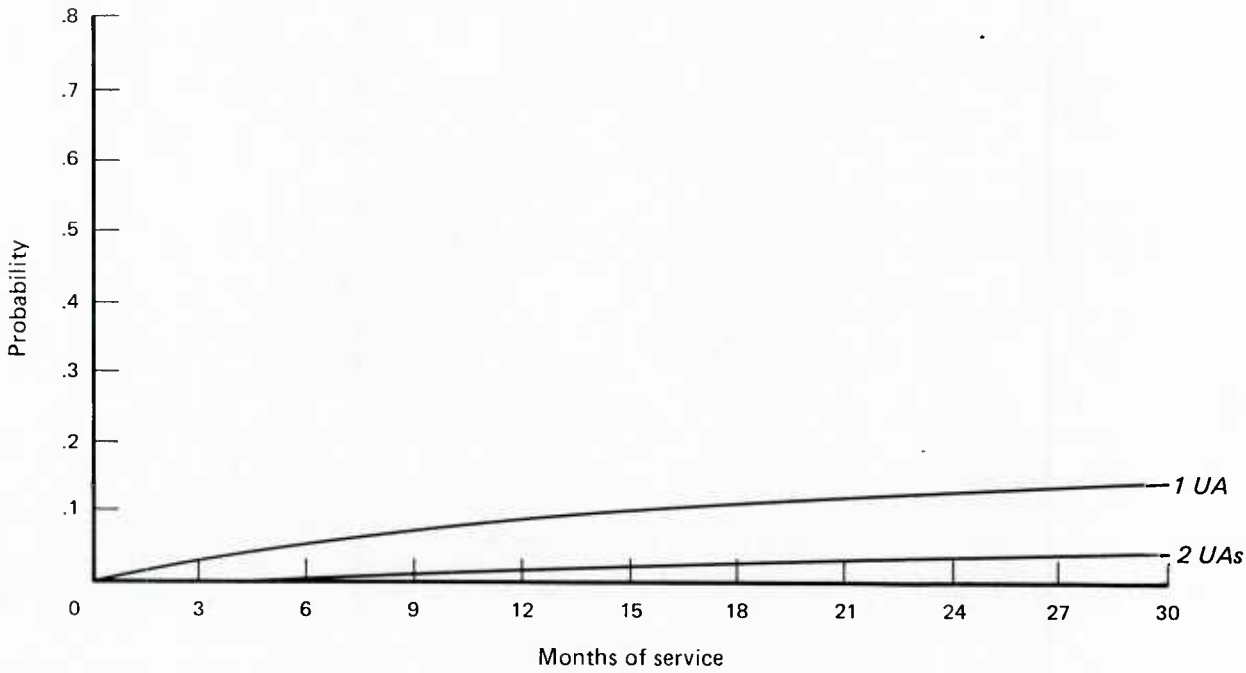

FIG. 8: UA PROBABILITIES FOR CASE 6

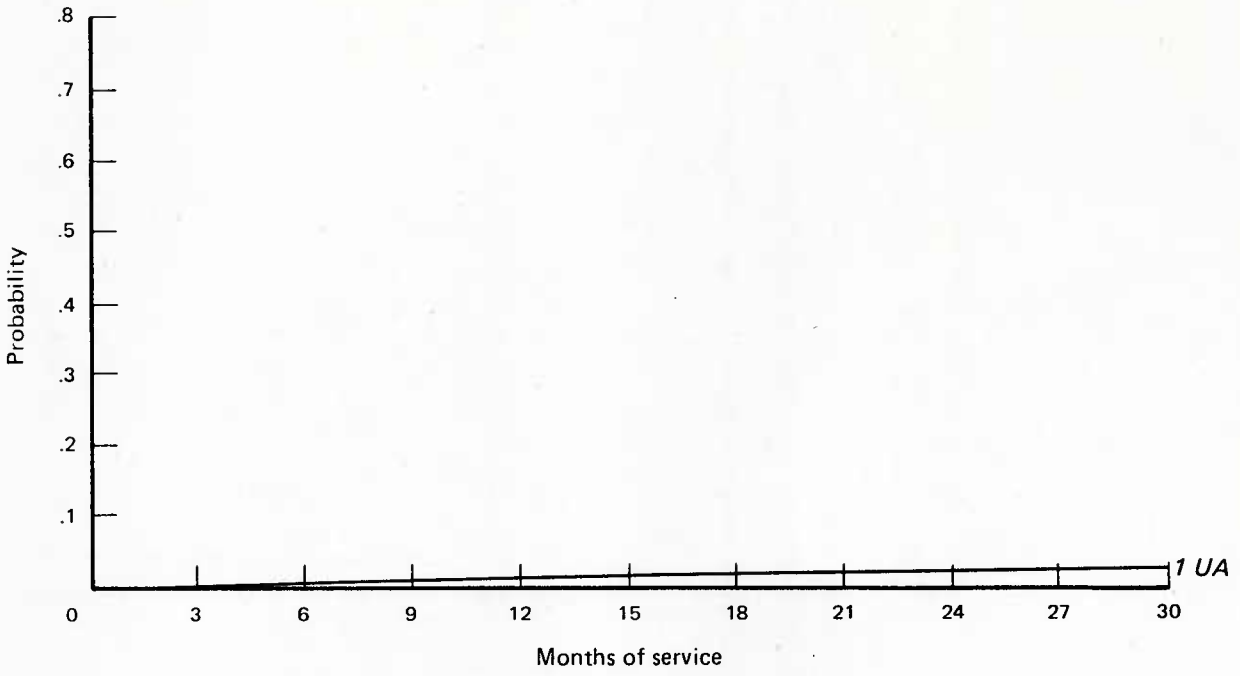

FIG. 9: UA PROBABILITIES FOR CASE 7

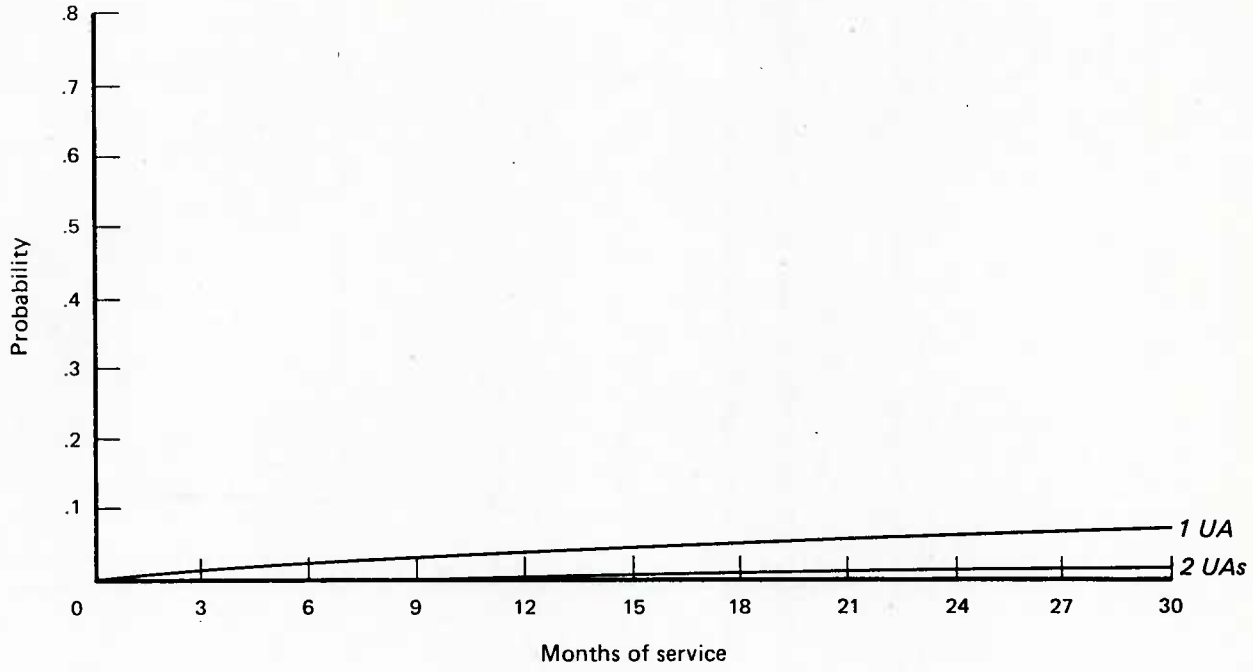

FIG. 10: UA PROBABILITIES FOR CASE 8

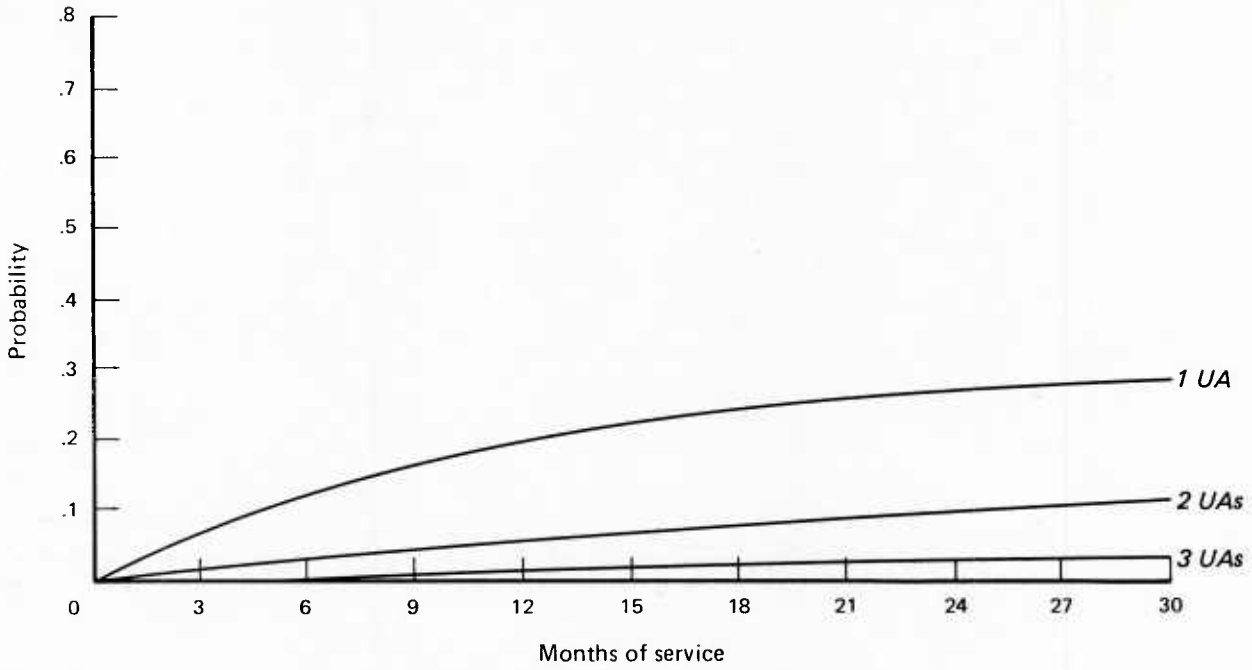

FIG. 11: UA PROBABILITIES FOR CASE 9

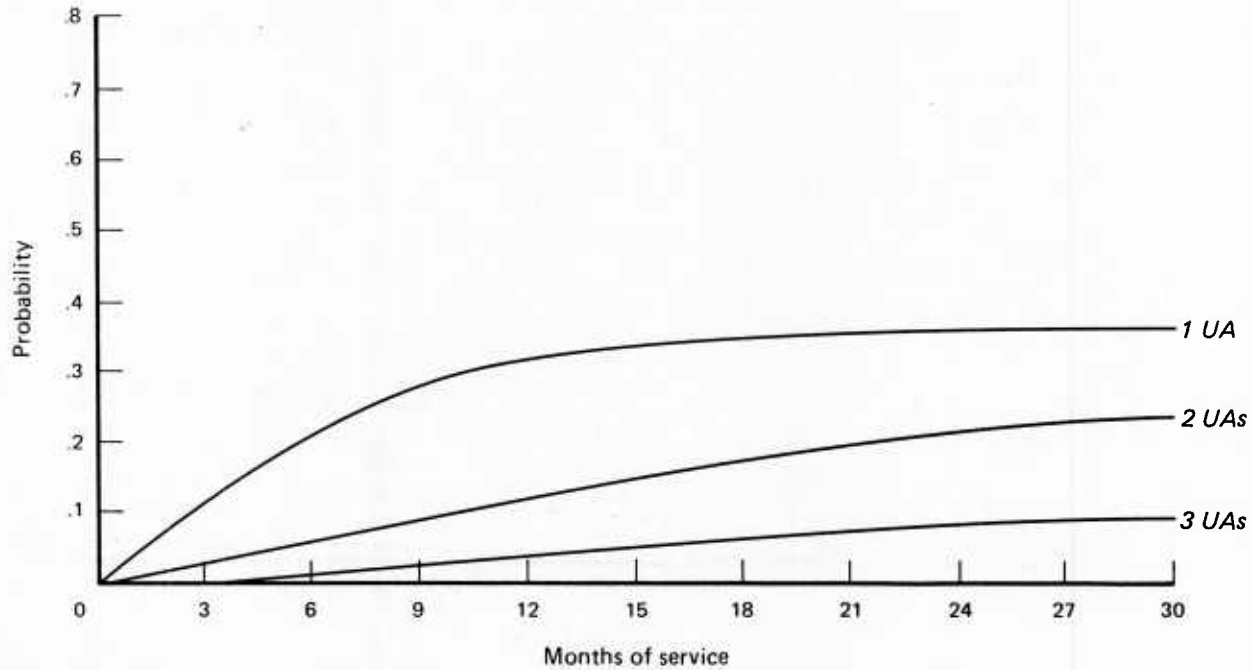

FIG. 12: UA PROBABILITIES FOR CASE 10

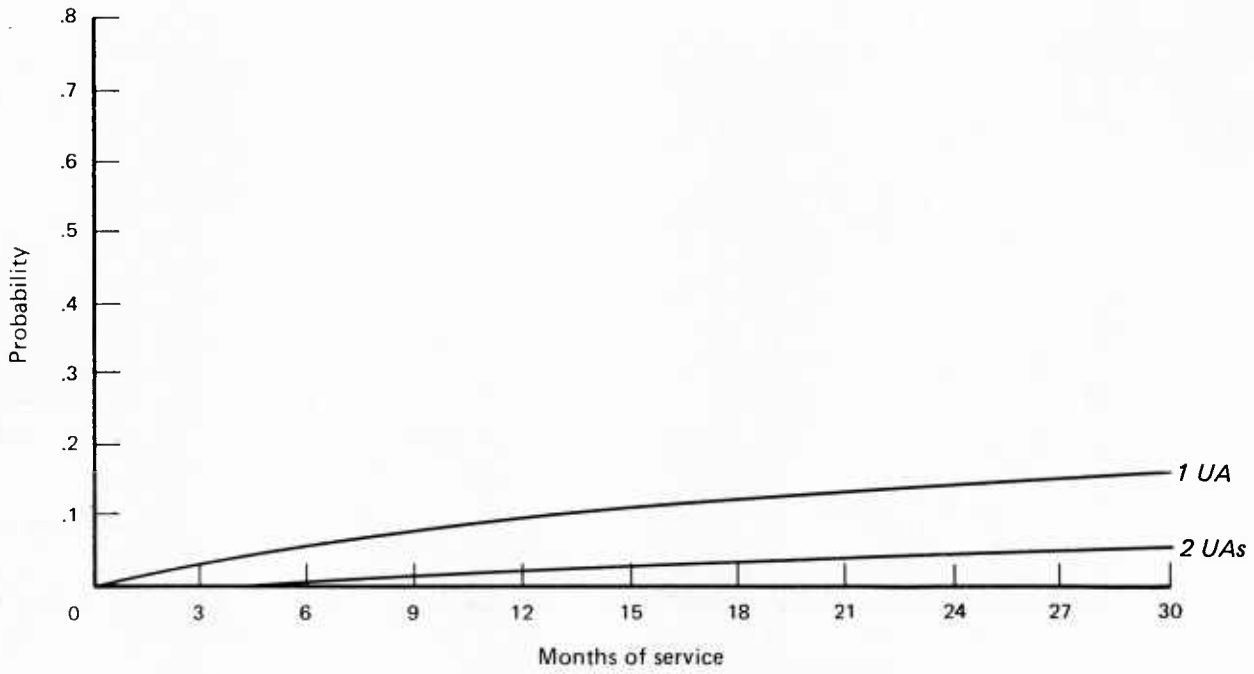

FIG. 13: UA PROBABILITIES FOR CASE 11

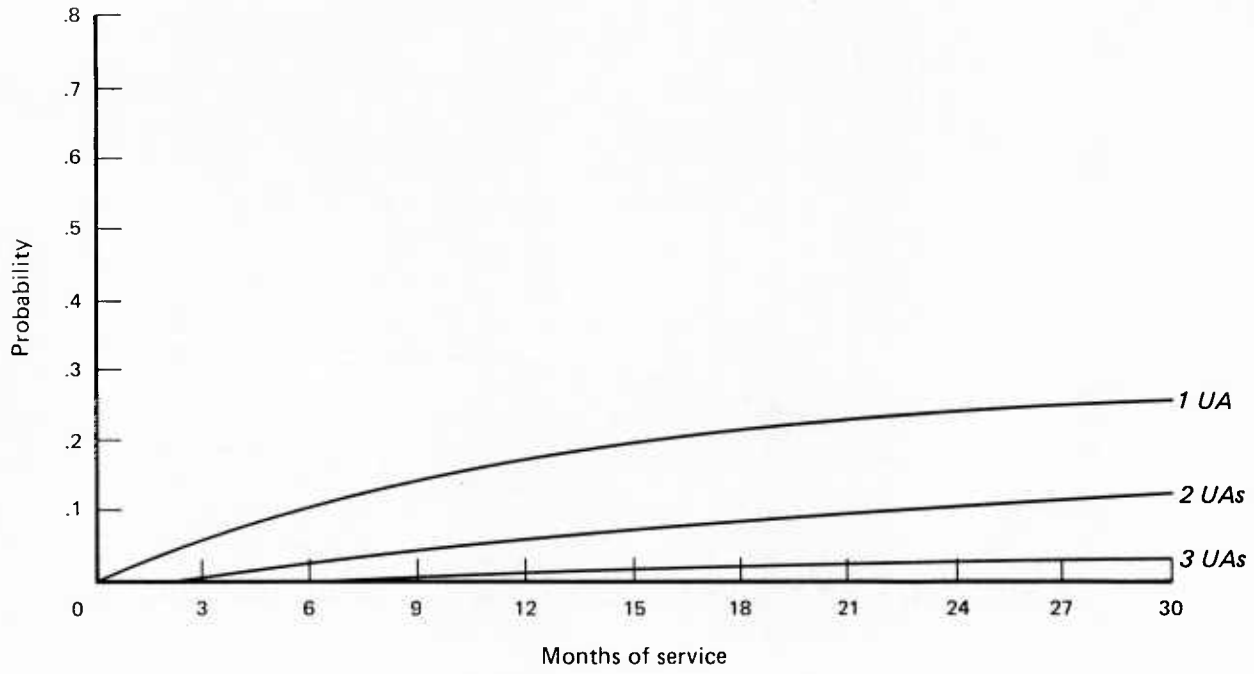

FIG. 14: UA PROBABILITIES FOR CASE 12

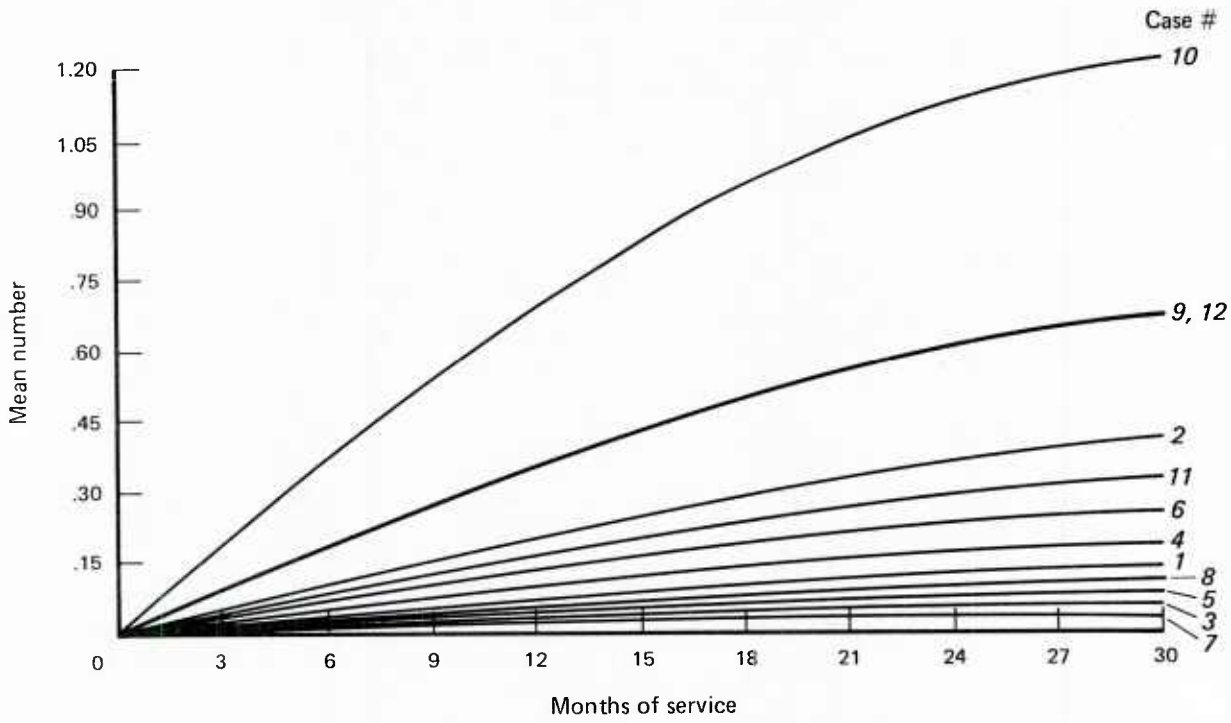

FIG. 15: MEAN NUMBER OF UAs FOR CASES 1-12

TABLE 27

MEAN LENGTHS AND STANDARD DEVIATIONS OF
UA OCCURRENCES BY RATING GROUP

	UA Number		
Rating Group	1	2	3
Electronics	11.5 (10.6)	14.0 (11.4)	--[a]
Cryptology	10.5 (12.4)	--[a]	--[a]
Ordnance	9.5 (7.9)	10.8 (9.0)	9.5 (10.0)
Deck	9.2 (8.1)	7.9 (8.0)	7.2 (7.3)
Hull	9.2 (8.3)	8.4 (8.2)	9.1 (8.5)
Construction	9.1 (8.6)	10.6 (9.6)	6.9 (8.3)
Administrative	8.5 (8.1)	8.8 (8.2)	7.6 (8.0)
Aviation	7.5 (7.4)	7.8 (7.8)	7.6 (8.2)
Medical	7.5 (7.7)	7.5 (7.5)	9.8 (8.2)

[a]Too few observations to accurately compute mean and standard deviation.

TABLE 28

MEAN LENGTHS AND STANDARD DEVIATIONS OF UA OCCURRENCES
BY APPRENTICESHIP GROUP

Apprenticeship Group	UA Number 1	2	3
Seaman - No "A" School	8.5 (7.9)	8.4 (8.0)	8.3 (7.8)
Seaman - "A" School Attrite	8.9 (8.3)	8.3 (7.8)	8.3 (7.6)
Airman - No "A" School	7.7 (7.6)	7.4 (7.5)	6.9 (6.5)
Airman - "A" School Attrite	8.7 (8.2)	9.4 (8.4)	7.8 (7.5)
Fireman - No "A" School	9.1 (8.3)	9.2 (8.2)	7.6 (7.1)
Fireman - "A" School Attrite	8.8 (8.2)	8.7 (8.1)	8.5 (7.4)

From table 29, UA occurrence lengths do not appear to depend on previous UA history, school guarantee, education, entry status, enlistment waiver (with the exception of SCREEN, which consists of few observations), and location. There is an inconsistent pattern of UA lengths across age levels, but in the 17-21 age range (which comprises the bulk of the enlistment pool), age does not make much difference. On the other hand, there are consistent patterns across mental group and paygrade. Again, we observe an inverse relationship between UA lengths and UA rates, with mean UA length decreasing as mental group declines and increasing as paygrade increases. Also, whites remain away from duty 2 days longer than non-whites, and 6-year obligors are absent 1.5 - 2 days longer than 3- , 4- , or 5-year obligors. Unit type also has an impact, with UA lengths of submarine personnel being about 2 days longer than those of carrier personnel.

TABLE 29

MEAN LENGTHS AND STANDARD DEVIATIONS OF UA OCCURRENCES
BY PERSONNEL AND UNIT CHARACTERISTICS

Characteristic	Value	UA Number 1	2	3
Previous UA History	Yes	8.9 (8.3)	8.6 (8.0)	8.1 (7.7)
	No	8.7 (8.1)	8.5 (8.1)	8.2 (7.7)
Age at Duty	17	9.2 (8.4)	8.6 (8.0)	7.5 (7.3)
	18	8.6 (8.0)	8.7 (8.3)	8.2 (7.7)
	19	8.5 (8.1)	8.2 (7.8)	8.5 (8.0)
	20	8.3 (8.0)	8.6 (8.2)	8.4 (7.8)
	21	8.6 (8.1)	9.0 (8.0)	8.4 (8.0)
	22	9.4 (8.4)	7.5 (8.0)	7.7 (6.9)
	23	8.2 (8.0)	7.7 (8.2)	7.8 (8.0)
	24	10.8 (9.4)	9.3 (8.1)	6.1 (8.6)
	25+	8.7 (7.8)	9.5 (8.9)	9.5 (8.1)
Mental Group	1	10.3 (8.9)	9.4 (9.1)	8.4 (7.1)
	2	9.6 (8.6)	9.4 (8.4)	8.6 (8.0)
	3U	8.9 (8.2)	8.4 (8.0)	7.6 (7.2)
	3L	8.1 (7.8)	8.1 (7.9)	9.0 (8.3)
	4A	7.8 (7.6)	8.1 (7.9)	7.6 (7.5)
	4B	7.9 (7.4)	8.4 (8.0)	8.2 (8.1)
	4C-5	7.1 (7.0)	8.7 (8.4)	5.9 (6.3)
Pay Grade at Duty	E-1	8.6 (8.0)	8.5 (8.1)	8.1 (7.6)
	E-2	8.4 (8.0)	8.5 (8.0)	8.0 (7.9)
	E-3	9.5 (8.8)	9.6 (8.4)	8.3 (7.2)
	E-4	10.8 (8.9)	7.7 (7.5)	12.8 (8.8)
School Guarantee	No	8.6 (8.0)	8.5 (8.1)	8.4 (7.9)
	Yes	8.8 (8.2)	8.6 (8.1)	8.0 (7.6)
Education	NHSG	8.8 (8.2)	8.5 (8.0)	8.2 (7.7)
	GED	9.3 (8.3)	8.1 (7.7)	8.9 (8.3)
	HSDG	8.4 (8.0)	8.7 (8.3)	7.9 (7.5)
Entry Status	Direct	8.7 (8.2)	8.6 (8.1)	8.2 (7.7)
	Delayed	8.7 (8.1)	8.5 (8.1)	8.2 (7.7)
Race	White	9.0 (8.3)	8.7 (8.2)	8.3 (7.7)
	Non-White	7.2 (7.1)	7.6 (7.3)	7.5 (7.6)

TABLE 29 (Cont'd)

Characteristic	Value	UA Number 1	2	3
Term of Enlistment	3 Years	8.4 (7.9)	8.5 (7.9)	8.1 (7.5)
	4 Years	8.6 (8.1)	8.5 (8.1)	8.1 (7.7)
	5 Years	8.1 (7.8)	9.2 (8.8)	7.3 (7.8)
	6 Years	10.2 (9.0)	9.3 (8.4)	9.4 (8.1)
Enlistment Waiver	Screen	11.6 (9.2)	--[a]	--[a]
	Felony	9.2 (8.7)	7.7 (7.1)	5.9 (6.7)
	Major Misdemeanor	9.0 (8.2)	8.3 (8.1)	7.9 (7.3)
	Minor Misdemeanor	9.0 (8.3)	9.6 (9.6)	6.6 (6.1)
	Drugs	8.8 (8.4)	8.9 (8.6)	9.4 (8.1)
	Other	8.7 (8.2)	8.4 (8.1)	9.6 (9.2)
	None	8.6 (8.0)	8.6 (8.0)	8.1 (7.7)
Unit Type	Submarine	9.7 (8.7)	11.0 (9.2)	10.0 (9.1)
	Cruiser-Destroyer	9.1 (8.3)	8.9 (8.4)	8.5 (7.9)
	Other	8.7 (8.3)	9.2 (8.5)	8.5 (8.1)
	General Duty	9.0 (8.3)	8.7 (8.1)	8.6 (7.8)
	Amphibious	8.9 (8.1)	8.9 (8.2)	8.2 (7.6)
	Support-Underway Replenishment	8.5 (8.0)	7.8 (7.8)	8.5 (7.7)
	Air	8.1 (7.7)	8.5 (7.9)	7.5 (7.5)
	Carrier	7.9 (7.7)	7.7 (7.4)	7.2 (7.2)
Location	CONUS	8.7 (8.1)	8.6 (8.1)	8.2 (7.7)
	Non-CONUS	8.4 (8.1)	8.2 (8.0)	7.3 (7.5)

[a]Too few observations to accurately compute mean and standard deviation.

REFERENCES

[1] Hartnagel, T. F., "Absent Without Leave: A Study of the Military Offender," Journal of Political and Military Sociology, Vol. 2, 1974

[2] Army Research Institute, Report Number 76-4, "Predicting Military Delinquency," by R. G. Bauer, R. L. Stout, and R. F. Holz, Unclassified, Aug 1976

[3] Littlepage, G. E. and Rappoport, L., "Factors Affecting Military AWOL Decisions," Journal of Political and Military Sociology, Vol. 5, 1977

[4] Shils, E., "A Profile of the Military Deserter," Armed Forces and Society, Vol. 3, 1977

[5] Army Research Institute, Report Number 78-6, "The Correlates of AWOL: 30 Years of Research into the Problem of AWOL in the U.S. Army," Unclassified, Aug 1978

[6] Naval Health Research Center, Report Number 77-16, "Personnel Effectiveness and Premature Attrition in the All-Volunteer Navy," by E. K. E. Gunderson and A. Hoiberg, Unclassified, 1977

[7] Naval Health Research Center, Report Number 80-33, "Unauthorized Absence, Desertion, and Attrition Rates for First-Term Navy Enlisted: A Twelve-Year Perspective," by E. K. E. Gunderson, Unclassified, 1980

[8] Rear Admiral J. R. Hogg to Distribution List, "Counter-UA Task Force Recommendation," Memo 135K/0912, Unclassified, 23 Sep 1981

[9] CNA, Research Contribution 402, "Non-Parametric Methods for Estimating Recruit Survival with Cross-Sectional Data," by P. M. Lurie, Unclassified, Sep 1979

[10] CNA, Memorandum 77-1755, "Predicting Survival of Navy Men from Pre-Service Characteristics After One, Two, and Three Years of Service," by R. F. Lockman, Unclassified, 15 Dec 1977

APPENDIX A

COMPUTATION OF UA PROBABILITIES

APPENDIX A

COMPUTATION OF UA PROBABILITIES

The computation of UA probabilities from the probit model, once the coefficients have been estimated, is a simple matter. The coefficients are taken from tables 15, 16, or 17, depending on the UA probability of interest. We then form the linear combination

$$\beta' X = \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k \ ,$$

where β is the vector of coefficients, X is the vector of personnel characteristics, and k is the number of characteristics. The probability of a UA is then

$$p = \int_{-\infty}^{\beta' X} dF(x) \ ,$$

where F is the unit normal c.d.f. The integral can be evaluated numerically, for example, with IMSL subroutine MDNOR.

APPENDIX B

GENERALIZED MARKOV BIRTH PROCESS

APPENDIX B

GENERALIZED MARKOV BIRTH PROCESS

Let $N(t)$ be a random variable denoting the number of events (e.g., UAs) which occur in the time interval $[0,t]$. Suppose we impose the following conditions on $N(t)$:

$$P\{N(t+h) - N(t) = 1\} = \lambda h + o(h) \quad ,$$

$$P\{N(t+h) - N(t) = 0\} = 1 - \lambda h + o(h) \quad ,$$

$$P\{N(t+h) - N(t) > 1\} = o(h) \quad ,$$

where $h \to 0$, λ is a constant denoting failure rate, and $o(h)$ is a function satisfying $o(h)/h \to 0$ as $h \to 0$. Suppose further that the number of events in disjoint time intervals is independent. Then $N(t)$ is a Poisson process with rate λ. As a further consequence of the above conditions, the times between successive events have independent exponential distributions with paramater λ.

Though widely used and computationally convenient, the Poisson process has underlying assumptions that are too strong to apply to sequences of UA occurrences. For instance, the assumption of independent interoccurrence times is unreasonable since several occurrences can come from one individual. Also, the assumption that the failure rate λ is constant is unreasonably restrictive; we can let it be a function of time $\lambda(t)$. The relaxation of these assumptions results in the following postulates:

$$P\{N(t+h) - N(t) = 1 \mid N(t) = k\} = \lambda_k(t) + o(h) \quad ,$$

$$P\{N(t+h) - N(t) = 0 \mid N(t) = k\} = 1-\lambda_k(t) + o(h) \quad ,$$

$$P\{N(t+h) - N(t) > 1 \mid N(t) = k\} = o(h) \quad .$$

These postulates define a generalized Markov birth process. It is called a birth process since it is commonly used to model the reproduction of living organisms, but it is clearly not limited to that application.

If we let $P_k(t)$ denote the probability of k events in time t, it can be shown that if $N(t)$ is a generalized Markov birth process, then

$$P_k(t) = e^{-\Lambda_k(t)} \int_0^t \lambda_{k-1}(x) e^{\Lambda_k(x)} P_{k-1}(x)dx, \quad k=1,2,\ldots \quad (1)$$

and

$$P_0(t) = e^{-\Lambda_o(t)}, \quad (2)$$

where $$\Lambda_k(x) = \int_0^x \lambda_k(u)du \ .$$

These equations can be solved recursively to yield solutions for $P_0(t)$, $P_1(t)$, $P_2(t)$, etc. Individual characteristics are brought into the process by modelling each $\lambda_k(t)$ by the Cox regression model. Then UA probabilities as a function of time for any combination of individual characteristics can be derived by substitution into (1) and (2).